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DURAPULSE GS10 DRIVE USER MANUAL

GS10_UMW

ORIGINAL INSTRUCTIONS

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Warnings and Trademarks

~ WARNING ~

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At a minimum, you should follow all applicable sections of the National Fire Code, National Electrical Code, and the codes of the National Electrical Manufacturer's Association (NEMA). There may be local regulatory or government offices that can also help determine which codes and standards are necessary for safe installation and operation.

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Warnings

WARNING: READ THIS MANUAL THOROUGHLY BEFORE USING DURAPULSE SERIES AC MOTOR DRIVES.

WARNING: AC INPUT POWER MUST BE DISCONNECTED BEFORE PERFORMING ANY MAINTENANCE. DO NOT CONNECT OR DISCONNECT WIRES OR CONNECTORS WHILE POWER IS APPLIED TO THE CIRCUIT. MAINTENANCE MUST BE PERFORMED ONLY BY A QUALIFIED TECHNICIAN.

WARNING: THERE ARE HIGHLY SENSITIVE MOS COMPONENTS ON THE PRINTED CIRCUIT BOARDS, AND THESE COMPONENTS ARE ESPECIALLY SENSITIVE TO STATIC ELECTRICITY. TO AVOID DAMAGE TO THESE COMPONENTS, DO NOT TOUCH THESE COMPONENTS OR THE CIRCUIT BOARDS WITH METAL OBJECTS OR YOUR BARE HANDS.

WARNING: A CHARGE MAY STILL REMAIN IN THE DC-LINK CAPACITOR WITH HAZARDOUS VOLTAGES, EVEN IF THE POWER HAS BEEN TURNED OFF. TO AVOID PERSONAL INJURY, DO NOT REMOVE THE COVER OF THE AC DRIVE UNTIL ALL "DISPLAY LED" LIGHTS ON THE DIGITAL KEYPAD ARE OFF. PLEASE NOTE THAT THERE ARE LIVE COMPONENTS EXPOSED WITHIN THE AC DRIVE. DO NOT TOUCH THESE LIVE PARTS.

WARNING: GROUND THE DURAPULSE AC DRIVE USING THE GROUND TERMINAL. THE GROUNDING METHOD MUST COMPLY WITH THE LAWS OF THE COUNTRY WHERE THE AC DRIVE IS TO BE INSTALLED. REFER TO "BASIC WIRING DIAGRAM" IN CHAPTER 2.

WARNING: THE MOUNTING ENCLOSURE OF THE AC DRIVE MUST COMPLY WITH EN50178. LIVE PARTS SHALL BE ARRANGED IN ENCLOSURES OR LOCATED BEHIND BARRIERS THAT MEET AT LEAST THE REQUIREMENTS OF THE PROTECTIVE TYPE IP20. THE TOP SURFACE OF THE ENCLOSURES OR BARRIER THAT IS EASILY ACCESSIBLE SHALL MEET AT LEAST THE REQUIREMENTS OF THE PROTECTIVE TYPE IP40. USERS MUST PROVIDE THIS ENVIRONMENT FOR DURAPULSE SERIES AC DRIVE.

WARNING: THE AC DRIVE MAY BE DESTROYED BEYOND REPAIR IF INCORRECT CABLES ARE CONNECTED TO THE INPUT/OUTPUT TERMINALS. NEVER CONNECT THE AC DRIVE OUTPUT TERMINALS T1, T2, AND T3 DIRECTLY TO THE AC MAIN CIRCUIT POWER SUPPLY.

THREE-PHASE DURAPULSE DRIVES REQUIRE A SYMMETRICAL 3-PHASE POWER SOURCE.
DO NOT CONNECT THEM TO GROUNDED, CENTER-TAPPED DELTA TRANSFORMERS OF THE TYPE TYPICALLY USED FOR LIGHTING CIRCUITS.

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DURAPULSE GS10 Drive User Manual Revision History

Please include the Manual Number and the Manual Issue, both shown below, when communicating with Technical Support regarding this publication.

Manual Number:	***GS10_UMW***
Issue:	***First Edition, Rev A***
Issue Date:	***June 27th, 2024***

Publication History		
Issue	***Date***	***Description of Changes***
First Edition	06/15/22	Original Issue
1st Ed, Rev A	06/27/24	Minor corrections throughout, updates to GSoft2 chapter.

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DURApulse GS10 Drive User Manual Table of Contents

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Getting Started

Chapter 1

Table of Contents

User Manual Overview

Overview of this Publication

The *DURAPULSE* GS10 Drive User Manual describes the installation, configuration, and methods of operation of the *DURAPULSE* GS10 Series AC Drive. Throughout this manual, please note:

- *GS10 refers to GS11 and GS13 models only*

Who Should Read This Manual

This manual contains important information for those who will install, maintain, and/or operate any of the GS10 Series AC Drives.

Supplemental Publications

The National Electrical Manufacturers Association (NEMA) publishes many different documents that discuss standards for industrial control equipment. Global Engineering Documents handles the sale of NEMA documents. For more information, you can contact Global Engineering Documents at:

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Englewood, CO 80112-5776
1-800-854-7179 (within the U.S.)
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Special Symbols

NOTE: When you see the "notepad" icon in the left-hand margin, the paragraph to its immediate right will be a special note.

WARNING: When you see the "exclamation mark" icon in the left-hand margin, the paragraph to its immediate right will be a warning. This information could prevent injury, loss of property, or even death (in extreme cases).

Purpose of AC Drives

AC drives are generally known by many different names: Adjustable Frequency Drives (AFD), Variable Frequency Drives (VFD), and Inverters. Drives are used primarily to vary the speed of three phase AC induction motors, and they also provide non-emergency start and stop control, acceleration and deceleration, and overload protection. By gradually accelerating the motor, drives can reduce the amount of motor startup inrush current.

AC drives function by converting incoming AC power to DC, which is then synthesized back into three phase output power. The voltage and frequency of this synthesized output power is directly varied by the drive, where the frequency determines the speed of the three phase AC induction motor.

Selecting the Proper Drive Rating

Determine Motor Full-Load Amperage (FLA)

Motor FLA is located on the nameplate of the motor.
NOTE: FLA of motors that have been rewound may be higher than stated.

Determine Motor Overload Requirements

Many applications experience temporary overload conditions due to starting requirements or impact loading. Most AC drives are designed to operate at 150% overload for 60 seconds. If the application requires an overload greater than 150% or longer than 60 seconds, the AC drive must be oversized.

NOTE: Applications that require replacement of existing motor starters with AC drives may require up to 600% overload.

Determine Application Type; Constant Torque or Variable Torque

This torque requirement has a direct effect on which drive to select. Variable Torque (VT) applications are generally easier to start; typically fans and pumps. Most other applications outside fans and pumps fall into the Constant Torque (CT) category (machine control, conveyors, etc.). If you are unsure of the application, assume Constant Torque. The specification, derating, and selection tables are generally segregated by Constant Torque and Variable Torque.

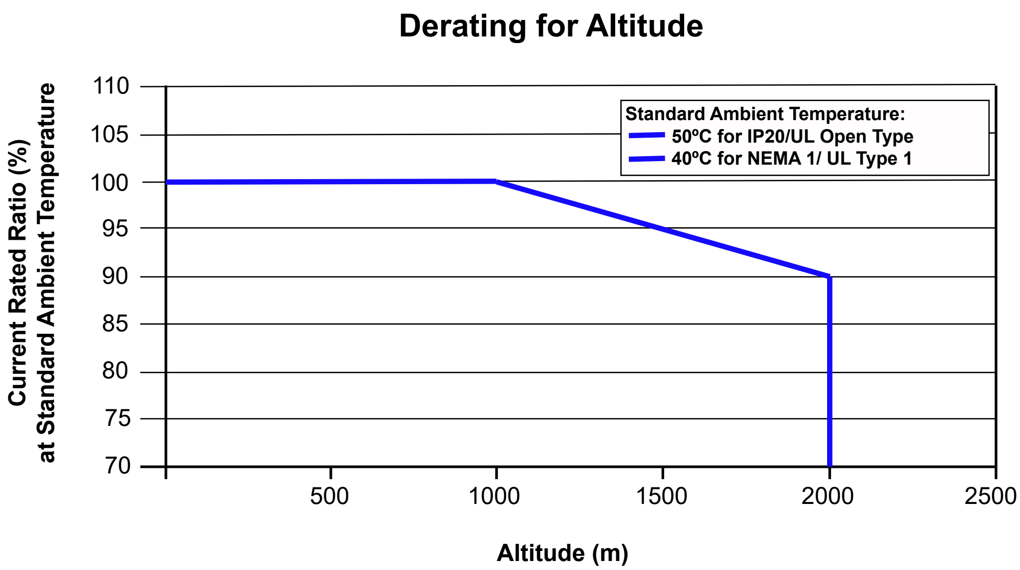
Installation Altitude

AC drives rely on air flow for cooling. As the altitude increases, the air becomes less dense, and this drop in air density decreases the cooling properties of the air. Therefore, the AC drive must be oversized to compensate for the decrease in cooling. Most AC drives are designed to operate at 100% capacity at altitudes up to 1000 meters.

NOTE: For use above 1000m, the AC drive must be derated as described below.

Derate Output Current Based on Altitude Above 1000 Meters

- *If the AC drive is installed at an altitude of 0~1000m, follow normal operation restrictions.*
- *If installed at an altitude of 1000~2000m, decrease 1% of the rated current or lower 0.5°C of temperature for every 100m increase in altitude.*
- *Maximum altitude for Corner Grounded is 2000m. If installation at an altitude higher than 2000m is required, please contact AutomationDirect.*



Determine Maximum Enclosure Internal Temperature

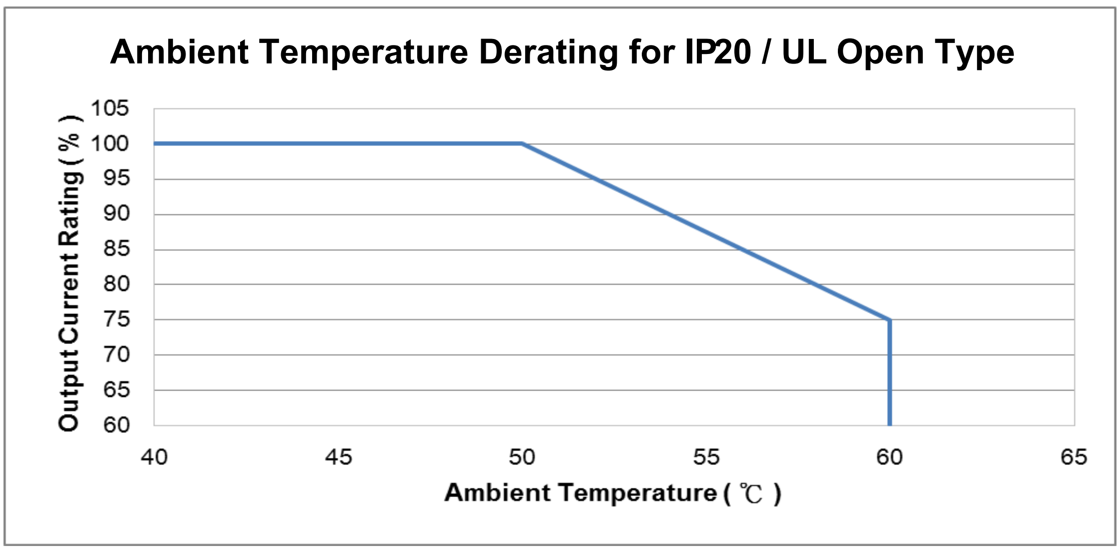
AC drives generate a significant amount of heat and will cause the internal temperature of an enclosure to exceed the rating of the AC drive, even when the ambient temperature is less than 104°F (40°C). Enclosure ventilation and/or cooling may be required to maintain a maximum internal temperature of 104°F (40°C) or less. Ambient temperature measurements/calculations should be made for the maximum expected temperature. When permissible, flange mounting the AC drive (mounting with the drive heatsink in open ambient air) can greatly reduce heating in the enclosure.

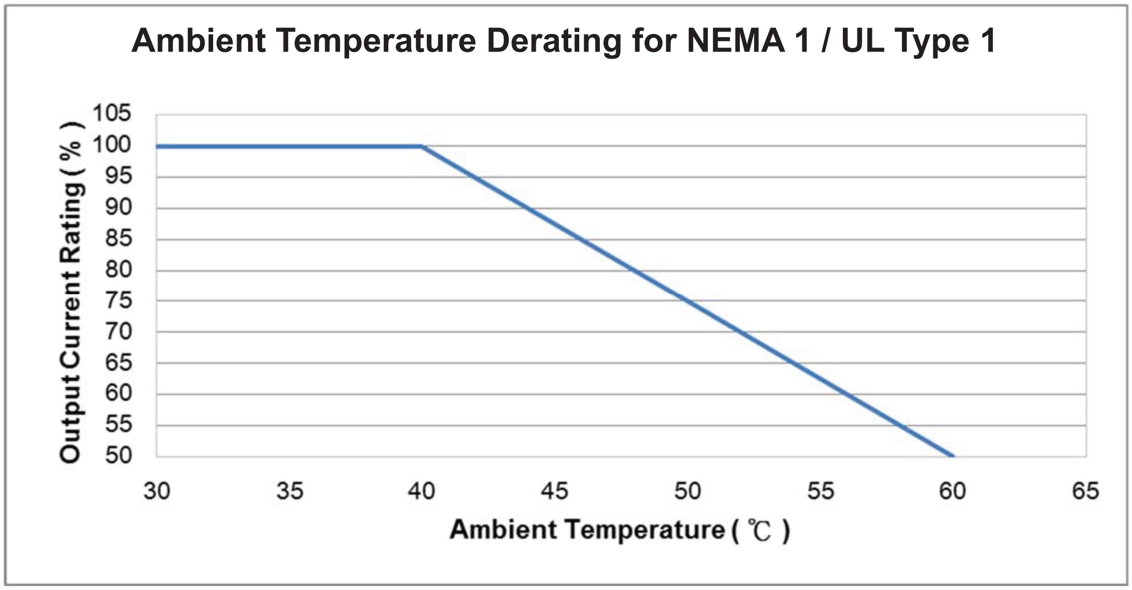
For use above 104°F (40°C), the AC drive must be derated as described below.

Derate Output Current Based on Temperature Above 104°F (40°C)

Drive Derating by Temperature and Protection Level	
Protection Level	***Derating***
UL Open Type / IP20 *	If the AC motor drive operates at the rated current, the ambient temperature needs to be between -20–50°C. If the temperature is above 50°C, decrease 2.5% of the rated current for every 1°C increase in temperature. The maximum allowable temperature is 60°C.
NEMA 1 / UL Type 1*	When the AC motor drive is operating at the rated current, the ambient temperature must be between -20–40°C. When the temperature is over 40 °C, for every increase by 1°C, decrease the rated current 2.5%. The maximum allowable temperature is 60°C.

** For more information about environmental ratings, refer to the "DURApulse GS10 AC Drive Environmental Information" on page 1–5 of this chapter.*




Ambient Temperature Derating for NEMA 1 / UL Type 1
Output Current Rating (%)
105
100
95
90
85
80
75
70
65
60
55
50
30
35
40
45
50
55
60
65
Ambient Temperature (℃)

Derate Output Current Based on Carrier Frequency (if necessary)

Carrier Frequency Effects

AC Drives rectify the incoming 50 or 60Hz line power resulting in DC power at 0Hz. The resulting DC power is then pulse-width modulated and supplied to the motor by the drive's power electronics. IGBTs invert the DC power, simulating a sine wave at the desired frequency (that's what allows variable speed in AC induction motors). The speed at which the IGBTs are turned ON and OFF is called Carrier Frequency. In AC drives, the Carrier Frequency can range from 2kHz to 15kHz. The Carrier Frequency can be adjusted in most AC Drives.

There are trade-offs between choosing High Carrier Frequencies and Low Carrier Frequencies.

Benefits of Higher Carrier Frequencies:

- *Better efficiency (lower harmonic losses) in the motor*
- *Lower audible noise*

Benefits of Lower Carrier Frequencies:

- *Better efficiency in the drive*
- *Lower EMI (electrical noise)*
- *Reduced reflective wave peak voltage*

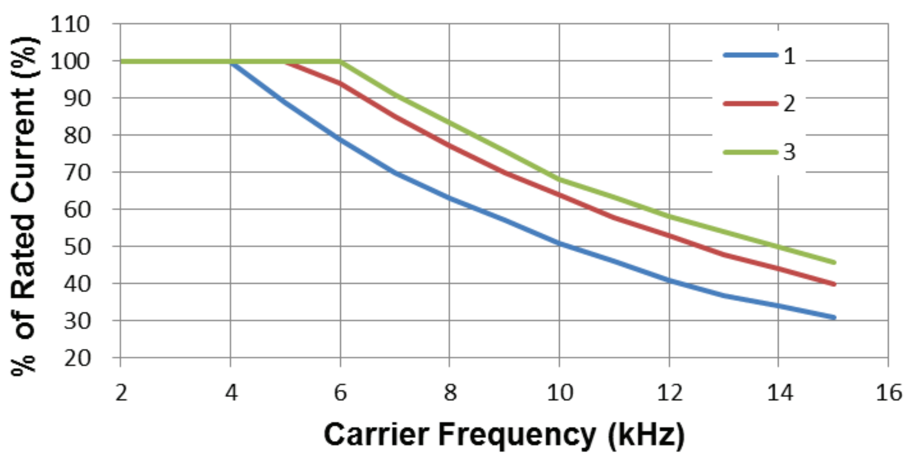
As a general rule, the Carrier Frequency should be set as low as possible without creating unacceptable audible noise in the motor. Smaller systems can have higher Carrier Frequencies, but larger drives (>20hp) should not have Carrier Frequencies set higher than 6kHz. Constant torque applications typically run around 2~4kHz.

GS10 Variable Torque Carrier Frequency Derating

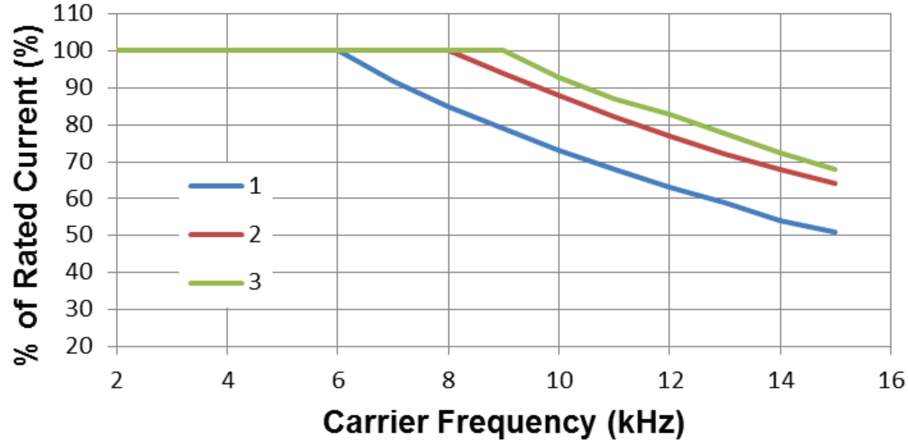
- *Line 1: Ta = 50°C / Load = 100%*
- *Line 2: Ta = 50°C / Load = 75% or Ta = 40°C / Load = 100%*
- *Line 3: Ta = 50°C / Load = 50% or Ta = 35°C / Load = 100%*

Note: Space Vector Pulse Width Modulation (SVPWM) and Two-Phase Pulse Width Modulation (DPWM) are determined by parameter P11.41. See Chapter 4 for details.

Variable Torque, SVPWM Mode

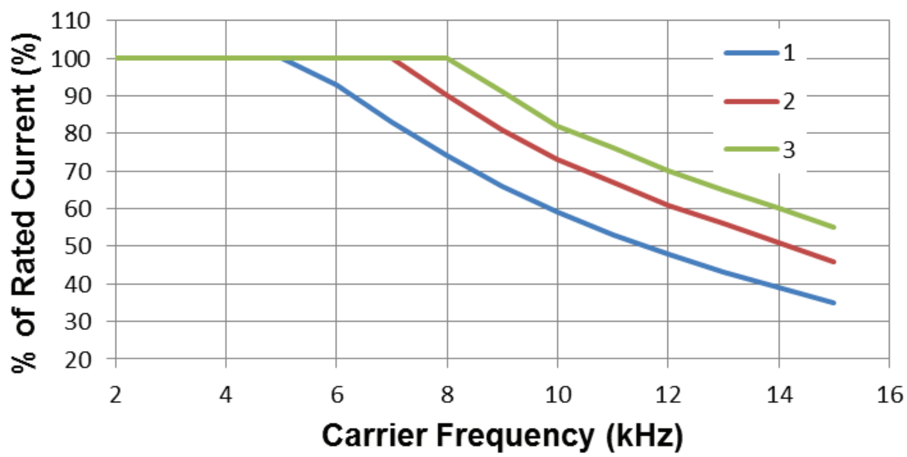


Variable Torque, DPWM Mode

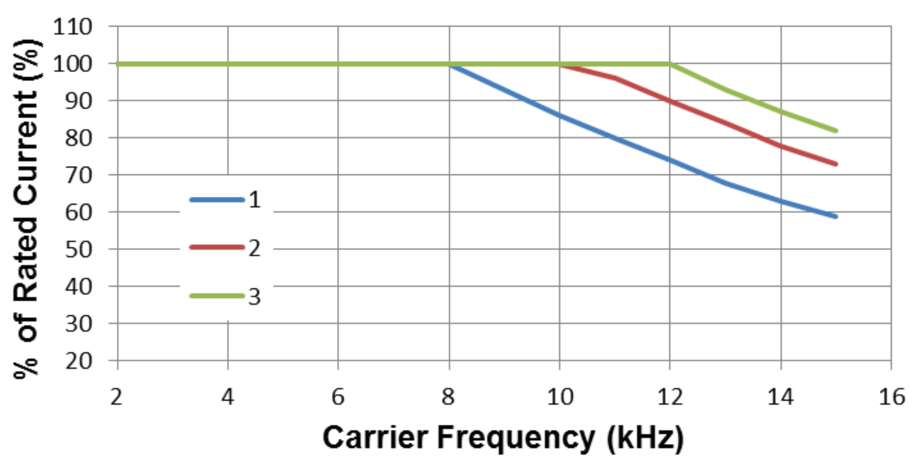


GS10 Constant Torque Carrier Frequency Derating

Constant Torque, SVPWM Mode



Constant Torque, DPWM Mode



DURAPULSE GS10 AC Drive Environmental Information

Storage and Transportation

AC drives should be kept in the shipping cartons or crates until they are installed. In order to retain the warranty coverage, they should be stored as described below if not to be installed and used within three months.

- *Store in a clean and dry location free from direct sunlight and corrosive fumes.*
- *Store within environmental conditions shown below in the "Environmental Conditions" table.*
- *DO NOT store in an area with rapid changes in temperature , to avoid condensation and frost.*
- *DO NOT place directly on the ground.*

If the drive is stored or is otherwise unused for more than a year, the drive's internal DC link capacitors should be recharged before use. Otherwise, the capacitors may be damaged when the drive starts to operate. We recommend recharging the capacitors of any unused drive at least once per year. (Refer to Chapter 6, "Maintenance and Troubleshooting" for information about recharging DC link capacitors.)

GS10 Environmental Conditions

Environmental Conditions for GS10 AC Drives			
Condition	Operation	Storage	Transportation
Installation Location	IEC 60364-1/ IEC 60664-1 Pollution degree 2, Indoor use only.	n/a	n/a
Ambient Temperature	IP20/UL Open Type: -20–50°C (-20–60°C w/derating)	-40–85°C	-20–70°C
	IP20 side-by-side or NEMA1/UL Type 1: -20–40°C (-20–55°C w/derating)		
	Non-condensing, non-freezing		
Relative Humidity	90%, no water condensation	95%, no water condensation	
Air Pressure	86–106 kPa	70–106 kPA	
Pollution Level	Concentrate prohibited		
	Class 3C2; Class 3S2	Class 2C2; Class 2S2	Class 1C2; Class 1S2
Altitude	<1000 m (For altitudes > 1000 m, derating required)		
Package Drop	n/a	ISTA procedure 1A (according to weight) IEC 60068-2-31	
Vibration	1.0 mm, peak to peak value range from 2–13.2 Hz; 0.7–1.0 G range from 13.2–55 Hz; 1.0 G range from 55–512 Hz. Compliance with IEC 60068-2-6	2.5 G peak, 5 Hz–2 kHz 0.015" maximum displacement	
Impact	15 G, 11 ms, compliance with IEC/EN60068-2-27	30G	
DO NOT expose the GS10 AC Drive to harsh environments such as dust, direct sunlight, corrosive/flammable gases, humidity, liquid, or vibrations. The salts in the air must be less than 0.01 mg/cm² every year.			

GS10 General Specifications

General Specifications for GS10 AC Drives			
Control Characteristics	Control Method	V/F, Sensorless Vector (SVC)	
	Applicable Motor	IM (Induction Motor), Permanent Magnet AC (IPM and SPM)	
	Starting Torque[1]	150% / 3 Hz	(V/F, SVC control for IM, CT)
		100% / (motor rated frequency/20)	(SVC control for PM, CT)
	Speed Control Range[1]	1: 50 (V/F, SVC control for IM, CT) 1: 20 (SVC control for PM, CT)	
	Max. Output Frequency	0.00–599.00 Hz	
	Overload Capacity	VT: rated output current of 120% 60 sec., 150% 3 sec. CT: rated output current of 150% 60 sec., 200% 3 sec.	
	Frequency Setting Signal	0–10 V / 4(0)–20 mA PWM pulse width input, pulse input (10kHz)	
	Digital Inputs	Five (5) - 24VDC NPN or PNP, includes 1 frequency input 10kHz	
	Digital Outputs	Two (2) - (1)-48VDC, (1) Relay-250VAC/30VDC	
	Analog Inputs	One (1) - Selectable Voltage or Current	
	Analog Outputs	One (1) - Voltage	
	Main Functions	• Multiple motor switching (max 2 motor settings) • Fast start-up • Deceleration Energy Back (DEB) function • Fast deceleration function • Master and Auxiliary frequency source selectable • Restart after momentary power loss • Speed tracking • Over-torque detection • 16-step speed (including the master speed) • Accel./decel. time switch • S-curve accel./decel. • Three-wire operation control • JOG frequency, • Frequency upper/lower limit settings • DC brake at start-up and stop • PID control • Simple Positioning Function • Multi Pump Sequence • RS-485 Serial Communications	
	Application Macro	Built-in application parameter groups (selected by industry) and user-defined application parameter groups.	
Protection Characteristics	Motor Protection	Over-current, Over-voltage, Over-heating, Phase loss, Over-load.	
	Stall Prevention	Stall prevention during acceleration, deceleration and running (independent settings).	
Agency Approvals	UL, CE, REACH		
1: Control accuracy may vary depending on the environment, application conditions, or motor type. For more information contact AutomationDirect.			

Efficiency Class

The EU Ecodesign regulation directive establishes a framework to set mandatory ecological requirements for energy-using and energy-related products. The IEC 61800-9-2 standard defines the efficiency classes for AC drives. The efficiency classes range (low to high) from IE0 to IE2. These classes apply to AC drives rated 100 to 1000 V and 0.12 to 1000 kW (1/6 to 1,340 HP).

Drive manufacturers must declare power losses in terms of percentage of rated apparent output power at eight different operating points, as well as standby losses. The International Efficiency (IE) level is given at the nominal point.

The power losses of GS10 series drives shall not exceed the maximum power losses corresponding to the IE2 efficiency level. For specific power losses of each drive model, see the drive specification tables.

DURAPULSE GS10 AC Drive Specifications

120V Class – 1-Phase Model-Specific Specifications

<table>
<tr><th colspan="7">GS10 120V Class Specifications; Frame Size A, C [1]</th></tr>
<tr><td colspan="4">Model Name: GS11N-1xPx</td><td>GS11N-10P2</td><td>GS11N-10P5</td><td>GS11N-11P0</td></tr>
<tr><td colspan="4">Frame Size</td><td>A1</td><td>A3</td><td>C1</td></tr>
<tr><td rowspan="8">Output Rating</td><td colspan="2" rowspan="2">Max Motor Output</td><td>hp</td><td>1/4</td><td>1/2</td><td>1</td></tr>
<tr><td>kW</td><td>0.2</td><td>0.4</td><td>0.75</td></tr>
<tr><td rowspan="3">CT</td><td>Rated Output Capacity</td><td>kVA</td><td>0.6</td><td>1.0</td><td>1.8</td></tr>
<tr><td>Rated Output Current</td><td>A</td><td>1.6</td><td>2.5</td><td>4.8</td></tr>
<tr><td>Carrier Frequency[4]</td><td>kHz</td><td colspan="3">2–15</td></tr>
<tr><td rowspan="3">VT</td><td>Rated Output Capacity</td><td>kVA</td><td>0.7</td><td>1.0</td><td>2.1</td></tr>
<tr><td>Rated Output Current</td><td>A</td><td>1.8</td><td>2.7</td><td>5.5</td></tr>
<tr><td>Carrier Frequency[4]</td><td>kHz</td><td colspan="3">2–15</td></tr>
<tr><td rowspan="5">Input Rating[2]</td><td>CT</td><td>Rated Input Current</td><td>A</td><td>6</td><td>9.4</td><td>18</td></tr>
<tr><td>VT</td><td>Rated Input Current</td><td>A</td><td>6.8</td><td>10.1</td><td>20.6</td></tr>
<tr><td colspan="3">Rated Voltage/Frequency[3]</td><td colspan="3">One-phase: 100–120 VAC (-15% to +10%), 50/60 Hz</td></tr>
<tr><td colspan="3">Operating Voltage Range (VAC)</td><td colspan="3">85–132</td></tr>
<tr><td colspan="3">Frequency Tolerance (Hz)</td><td colspan="3">47–63</td></tr>
<tr><td colspan="4">IE2 Efficiency - Relative Power Loss</td><td>4.3%</td><td>3.2%</td><td>2.9%</td></tr>
<tr><td colspan="4">Weight (kg)</td><td>0.4</td><td>0.5</td><td>1</td></tr>
<tr><td colspan="4">Cooling Method</td><td colspan="2">Convective</td><td>Fan</td></tr>
<tr><td colspan="4">IP Rating</td><td colspan="3">IP20</td></tr>
<tr><td colspan="7">1 - For use with three-phase motors only.
2 - Please refer to Appendix A - Accessories for input fusing information.
3 - For 120V single phase input power, remove the drive RFI jumper. See Circuit Connections - RFI Jumpers in Chapter 2.
4 - If application requires adjustment of the carrier frequency above default, refer to “Derate Output Current Based on Carrier Frequency (if necessary)” on page 1–7</td></tr>
</table>

230V Class – 1-Phase Model-Specific Specifications

GS10 230V Class Specifications; Frame Size A, B, C[1]								
Model Name: GS11N-2xPx				**GS11N-20P2**	**GS11N-20P5**	**GS11N-21P0**	**GS11N-22P0**	**GS11N-23P0**
Frame Size				**A1**	**A3**	**B2**	**C1**	**C1**
Output Rating	**Max Motor Output**		**hp**	1/4	1/2	1	2	3
			kW	0.2	0.4	0.75	1.5	2.2
	CT	**Rated Output Capacity**	**kVA**	0.6	1.1	1.8	2.9	4.2
		Rated Output Current	**A**	1.6	2.8	4.8	7.5	11
		Carrier Frequency[4]	**kHz**	2–15				
	VT	**Rated Output Capacity**	**kVA**	0.7	1.2	1.9	3.2	4.8
		Rated Output Current	**A**	1.8	3.2	5	8.5	12.5
		Carrier Frequency[4]	**kHz**	2–15				
Input Rating[2]	**CT**	**Rated Input Current**	**A**	5.1	7.3	10.8	16.5	24.2
	VT	**Rated Input Current**	**A**	5.8	8.3	11.3	18.5	27.5
	Rated Voltage/Frequency[3]			One-phase 200-240 VAC (-15% to +10%), 50/60 Hz				
	Operating Voltage Range (VAC)			170–265				
	Frequency Tolerance (Hz)			47–63				
IE2 Efficiency - Relative Power Loss				4.7%	3.1%	2.7%	2.5%	2.4%
Weight (kg)				0.4	0.5	0.8	1	1
Cooling Method				Convective				Fan
IP Rating				IP20				

1 - For use with three-phase motors only.
2 - Please refer to "Appendix A - Accessories" for input fusing information.
3 - For input power that is a floating ground or IT type, the RFI jumper must be removed. See "Floating Ground System (IT Systems)" on page 2–12.
4 - If application requires adjustment of the carrier frequency above default, refer to "Derate Output Current Based on Carrier Frequency (if necessary)" on page 1–7.

230V Class – 3-Phase Model-Specific Specifications

GS10 230V Class Specifications; Frame Size A, B[1]							
Model Name: GS13N-2xPx				***GS13N-20P2***	***GS13N-20P5***	***GS13N-21P0***	***GS13N-22P0***
Frame Size				***A1***	***A2***	***A5***	***B1***
Output Rating	***Max Motor Output (3-phase [1-phase])***		***hp***	1/4 [0.1]	1/2 [1/4]	1 [1/2]	2 [1]
			kW	0.2 [0.1]	0.4 [0.2]	0.75 [0.375]	1.5 [0.75]
	CT	***Rated Output Capacity***	***kVA***	0.6	1.1	1.8	2.9
		Rated Output Current (3-phase [1-phase])	***A***	1.6 [0.8]	2.8 [1.4]	4.8 [2.4]	7.5 [3.75]
		Carrier Frequency[4]	***kHz***	2–15			
	VT	***Rated Output Capacity***	***kVA***	0.7	1.2	1.9	3.0
		Rated Output Current	***A***	1.8	3.0	5.0	8.0
		Carrier Frequency[4]	***kHz***	2–15			
Input Rating[2]	***CT***	***Rated Input Current (3-phase and 1-phase)***	***A***	1.9	3.4	5.8	9.0
	VT	***Rated Input Current***	***A***	2.2	3.8	6.0	9.6
	Rated Voltage/Frequency[3]			3-phase 200-240 VAC (-15% to +10%), 50/60 Hz			
	Operating Voltage Range (VAC)			170–265			
	Frequency Tolerance (Hz)			47–63			
IE2 Efficiency - Relative Power Loss				4.7%	3.1%	2.7%	2.4%
Weight (kg)				0.4	0.5	0.6	0.8
Cooling Method				Convective			Fan
IP Rating				IP20			

1 - For use with three-phase motors only.
2 - Please refer to "Appendix A - Accessories" for input fusing information.
3 - For input power that is a floating ground or IT type, the RFI jumper must be removed. See "Floating Ground System (IT Systems)" on page 2–12.
4 - If application requires adjustment of the carrier frequency above default, refer to "Derate Output Current Based on Carrier Frequency (if necessary)" on page 1–7.

230V Class – 3-Phase Model-Specific Specifications

GS10 230V Class Specifications; Frame Size C, D[1]						
Model Name: GS13N-2xPx				***GS13N-23P0***	***GS13N-25P0***	***GS13N-27P5***
Frame Size				***C1***	***C1***	***D1***
Output Rating	***Max Motor Output (3-phase [1-phase])***		***hp***	3 [1.5]	5 [2.5]	7.5 [3.5]
			kW	2.2 [1.1]	3.7 [1.85]	5.5 [2.75]
	CT	***Rated Output Capacity***	***kVA***	4.2	6.5	9.5
		Rated Output Current (3-phase [1-phase])	***A***	11 [5.5]	17 [8.5]	25 [12.5]
		Carrier Frequency[4]	***kHz***	2–15		
	VT	***Rated Output Capacity***	***kVA***	4.8	7.4	10.3
		Rated Output Current	***A***	12.5	19.5	27
		Carrier Frequency[4]	***kHz***	2–15		
Input Rating[2]	***CT***	***Rated Input Current (3-phase and 1-phase)***	***A***	13.2	20.0	30.0
	VT	***Rated Input Current***	***A***	15.0	23.4	32.4
	Rated Voltage/Frequency[3]			3-phase 200-240 VAC (-15% to +10%), 50/60 Hz		
	Operating Voltage Range (VAC)			170–265		
	Frequency Tolerance (Hz)			47–63		
IE2 Efficiency - Relative Power Loss				2.4%	2.2%	2.3%
Weight (kg)				1	1	2
Cooling Method				Fan		
IP Rating				IP20		

1 - For use with three-phase motors only.

2 - Please refer to "Appendix A - Accessories" for input fusing information.

3 - For input power that is a floating ground or IT type, the RFI jumper must be removed. See "Floating Ground System (IT Systems)" on page 2–12.

4 - If application requires adjustment of the carrier frequency above default, refer to "Derate Output Current Based on Carrier Frequency (if necessary)" on page 1–7.

460V Class – 3-Phase Model-Specific Specifications

GS10 460V Class Specifications; Frame Size A, B[1]						
Model Name: GS13N-4xPx				GS13N-40P5	GS13N-41P0	GS13N-42P0
Frame Size				A4	A6	B1
Output Rating	Max Motor Output		hp	1/2	1	2
			kW	0.4	0.75	1.5
	CT	Rated Output Capacity	kVA	1.1	2.1	3.2
		Rated Output Current	A	1.5	2.7	4.2
		Carrier Frequency[4]	kHz	2–15		
	VT	Rated Output Capacity	kVA	1.4	2.3	3.5
		Rated Output Current	A	1.8	3.0	4.6
		Carrier Frequency[4]	kHz	2–15		
Input Rating[2]	CT	Rated Input Current	A	2.1	3.7	5.8
	VT	Rated Input Current	A	2.5	4.2	6.4
	Rated Voltage/Frequency[3]			3-phase 380-480 VAC (-15% to +10%), 50/60 Hz		
	Operating Voltage Range (VAC)			323-528		
	Frequency Tolerance (Hz)			47–63		
IE2 Efficiency - Relative Power Loss				3.7%	2.5%	2.2%
Weight (kg)				0.6	0.7	0.8
Cooling Method				Convective		Fan
IP Rating				IP20		

1 - For use with three-phase motors only.

2 - Please refer to "Appendix A - Accessories" for input fusing information.

3 - For input power that is a floating ground or IT type, the RFI jumper must be removed. See "Floating Ground System (IT Systems)" on page 2–12.

4 - If application requires adjustment of the carrier frequency above default, refer to "Derate Output Current Based on Carrier Frequency (if necessary)" on page 1–7.

460V Class – 3-Phase Model-Specific Specifications

GS10 460V Class Specifications; Frame Size C, D[1]							
Model Name: GS13N-4xPx				**GS13N-43P0**	**GS13N-45P0**	**GS13N-47P5**	**GS13N-4010**
Frame Size				**C1**	**C1**	**D1**	**D1**
Output Rating	**Max Motor Output**		**hp**	3	5	7 1/2	10
			kW	2.2	3.7	5.5	7.5
	CT	**Rated Output Capacity**	**kVA**	4.2	6.9	9.9	13
		Rated Output Current	**A**	5.5	9	13	17.5
		Carrier Frequency[4]	**kHz**	2–15			
	VT	**Rated Output Capacity**	**kVA**	5.0	8.0	12	15.6
		Rated Output Current	**A**	6.5	10.5	14.5	19.8
		Carrier Frequency[4]	**kHz**	2–15			
Input Rating[2]	**CT**	**Rated Input Current**	**A**	6.1	9.9	14.3	19.3
	VT	**Rated Input Current**	**A**	7.2	11.6	16.0	21.8
	Rated Voltage/Frequency[3]			3-phase 380-480 VAC (-15% to +10%), 50/60 Hz			
	Operating Voltage Range (VAC)			323-528			
	Frequency Tolerance (Hz)			47–63			
IE2 Efficiency - Relative Power Loss				2.3%	2.0%	1.9%	1.9%
Weight (kg)				1	1	2	2
Cooling Method				Fan			
IP Rating				IP20			

1 - For use with three-phase motors only.
2 - Please refer to "Appendix A - Accessories" for input fusing information.
3 - For input power that is a floating ground or IT type, the RFI jumper must be removed. See "Floating Ground System (IT Systems)" on page 2–12.
4 - If application requires adjustment of the carrier frequency above default, refer to "Derate Output Current Based on Carrier Frequency (if necessary)" on page 1–7.

NOTE: 120VAC models do not have DC bus terminals.

Receiving and Inspection

Drive Package Contents

After receiving the GS10 AC drive, please check the following:

1) Make sure that the package includes the DURAPULSE GS10 AC drive and the Quick-Start Guide that matches your product.
2) Please inspect the unit after unpacking to assure it was not damaged during shipment. Make sure that the part number printed on the package corresponds with the part number indicated on the nameplate.
3) Make sure that the part number indicated on the nameplate corresponds with the part number of your order.
4) Make sure that the voltage for the wiring lies within the range as indicated on the nameplate. Please install the GS10 AC drive according to this manual.
5) Before applying the power, please make sure that all the devices, including power, motor, control board, and digital keypad are connected correctly.
6) When wiring the GS10 AC drive, please make sure that the wiring of input terminals "R/L1, S/L2, T/L3" and output terminals "U/T1, V/T2, W/T3" are correct to prevent drive damage.
7) When power is applied, select the language and set parameter groups via the digital keypad. When executing a trial run, please begin with a low speed, and then gradually increase the speed until the desired speed is reached.

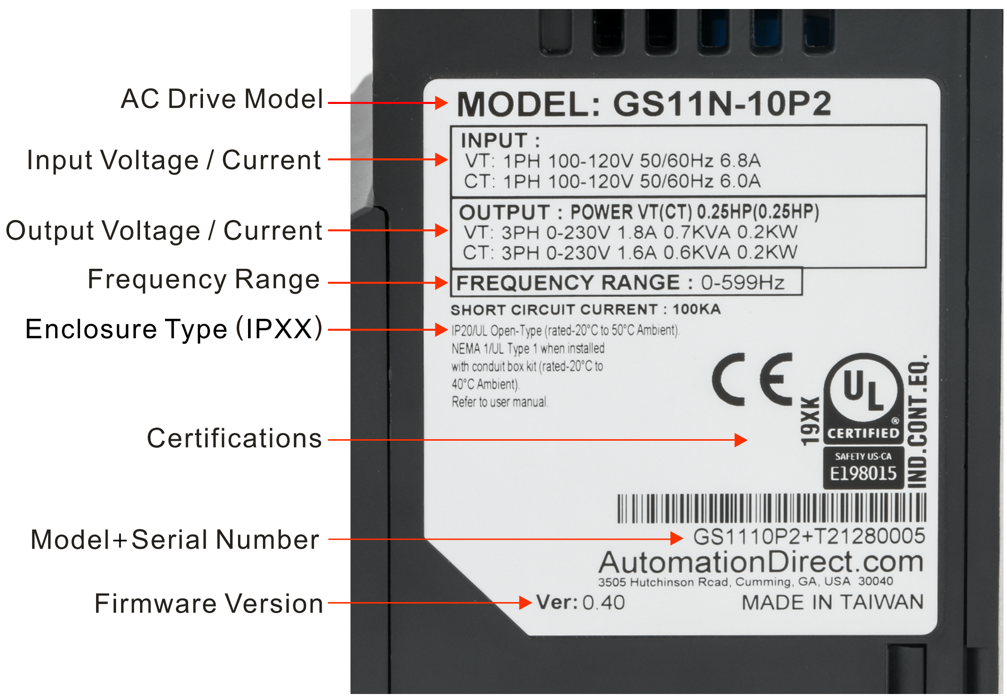
The GS10 AC drive should be kept in the shipping carton before installation. In order to retain the warranty coverage, the GS10 AC drive should be stored properly when it is not to be used for an extended period of time. Refer to the preceding "Environmental Information" section for proper storage conditions.

Model Number Explanation

GS11N-4 7P5

- **Applicable Motor Capacity***
  0P2: 0.25hp 0P5: 0.5hp 1P0: 1.0hp 2P0: 2.0hp
  3P0: 3.0hp 5P0: 5.0hp 7P5: 7.5hp 010: 10hp
  *Not all capacities are available in each voltage.
- **Input Voltage**
  1: 120VAC
  2: 230VAC
  4: 460VAC
- **Model Line**
  N: No Safe Torque Off (STO)
  A: Accessories
- **Phase**
  0: Not phase-specific
  1: One-phase
  3: Three-phase
- **Series Name**

Nameplate Information



Installation and Wiring

Chapter 2

Table of Contents

Drive Models by Frame Size

GS10 *DURApulse* Drive Models by Frame Size	
Frame	***Drive***
A	GS11N-10P2, GS11N-10P5, GS11N-20P2, GS11N-20P5, GS13N-20P2, GS13N-20P5, GS13N-21P0, GS13N-40P5, GS13N-41P0
B	GS11N-21P0, GS13N-22P0, GS13N-42P0
C	GS11N-11P0,GS11N-22P0, GS11N-23P0, GS13N-23P0, GS13N-25P0, GS13N-43P0, GS13N-45P0
D	GS13N-27P5, GS13N-47P5, GS13N-4010

Installation

Install the AC drive in an enclosure that is specifically designed to house electrical and electronic control equipment. Provide proper spacing within the enclosure to allow the dissipation of heat produced by the drive and any other included electrical and electronic equipment. Ventilation or air conditioning may also be required, depending upon the application.

Failure to observe these precautions may damage the drive and void the warranty!

Improper installation of the AC drive will greatly reduce its life. Observe the following precautions when installing the drive:

- *Do not mount the AC drive near heat-radiating elements or in direct sunlight.*
- *Do not install the AC drive in a place subjected to high temperature, high humidity, excessive vibration, corrosive gases or liquids, or airborne dust or metallic particles.*
- *Install the AC drive in Pollution Degree 2 environments only.*
  Pollution Degree 2: Normally only non-conductive pollution occurs. Temporary conductivity caused by condensation is to be expected.
- *Install the AC drive in a cabinet. When installing one drive below another, use a metal separator between the drives to prevent mutual heating and to prevent the risk of fire.*
- *Mount the AC drive securely on a flat, rigid, non-flammable surface.*
- *Mount the AC drive vertically and do not restrict the air flow to the heat sink fins.*
- *Prevent fiber particles, scraps of paper, shredded wood saw dust, metal particles, etc. from adhering to the heat sink.*

AC drives generate a large amount of heat which may damage them. Auxiliary cooling methods are typically required in order not to exceed maximum ambient temperatures.

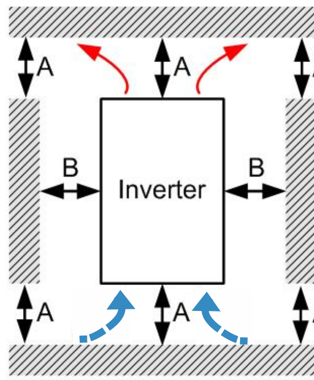
Minimum Clearances and Air Flow

Diagram Directional Arrows

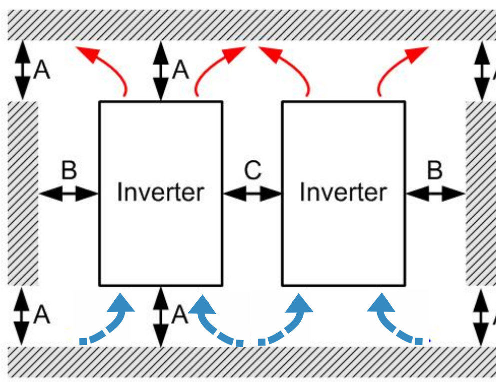
- *Air Inflow: Blue Arrow →→*
- *Air Outflow: Red Arrow →→*
- *Distance: Black Arrows ↔↔*

GS10 Series Minimum Clearance Distances

1) Single Drive Installation (Frames A–F)



2) Multiple Drives Side-By-Side



GS10 Minimum Mounting Clearances*					
Installation Method	***A (mm)***	***B (mm)***	***C (mm)***	***Operation Temperature (°C)***	
				Max (w/out derating)	***Max (Derating)***
Single drive installation	50	30	–	50	60
Side-by-side horizontal installation	50	30	30	50	60
Zero stack installation	50	30	0	40	50
** The minimum mounting clearances stated in this table apply to GS10 drives frames A to D. Failure to follow the minimum mounting clearances may cause the fan to malfunction and cause a heat dissipation problem.*					

GS10 Airflow and Power Dissipation

Model Number	Frame Size	Airflow Rate for Cooling: Flow Rate (cfm)	Airflow Rate for Cooling: Flow Rate (m^3/hr)	Power Dissipation (Watts): Loss External (Heat sink)	Power Dissipation (Watts): Internal	Power Dissipation (Watts): Total
GS11N-10P2	A	0	0	8	10	18
GS11N-10P5				14.2	13.1	27.3
GS11N-11P0	C	16	27.2	29.1	23.9	53
GS11N-20P2	A	0	0	8.6	10	18.6
GS11N-20P5				16.3	14.5	30.8
GS11N-21P0	B	10	16.99	29.1	20.1	49.2
GS11N-22P0	C	16	27.2	46.5	31	77.5
GS11N-23P0				70	35	105
GS13N-20P2	A	0	0	8.6	10	18.6
GS13N-20P5				16.5	12.6	29.1
GS13N-21P0				31	13.2	44.2
GS13N-22P0	B	10	16.99	50.1	24.2	74.3
GS13N-23P0	C	16	27.2	76	30.7	106.7
GS13N-25P0				108.2	40.1	148.3
GS13N-27P5	D	23.4	39.7	192.8	53.3	246.1
GS13N-40P5	A	0	0	17.6	11.1	28.7
GS13N-41P0				30.5	17.8	48.3
GS13N-42P0	B	10	16.99	45.9	21.7	67.6
GS13N-43P0	C	16	27.2	60.6	22.8	83.4
GS13N-45P0				93.1	42	135.1
GS13N-47P5	D	23.4	39.7	132.8	39.5	172.3
GS13N-4010				164.7	55.8	220.5

- Published flow rates are the result of active cooling using fans, factory installed in the drive.
- Unpublished flow rates (0.0) are the result of passive cooling in drives without factory installed fans.
- The required airflow shown in the chart is for installing a single GS10 drive in a confined space.
- When installing multiple GS10 drives, the required air volume would be the required air volume for a single GS10 drive multiplied by the number of GS10 drives.
- When calculating power dissipation (Watt Loss), use the Total value. Heat dissipation shown in the chart is for installing a single GS10 drive in a confined space.
- When installing multiple drives, the volume of heat/power dissipation should be the heat/power dissipated by a single GS10 drive multiplied by the number of GS10 drives.
- Heat dissipation for each model is calculated by rated voltage, current and default carrier frequency.

Dimensions

(Units = mm [in])

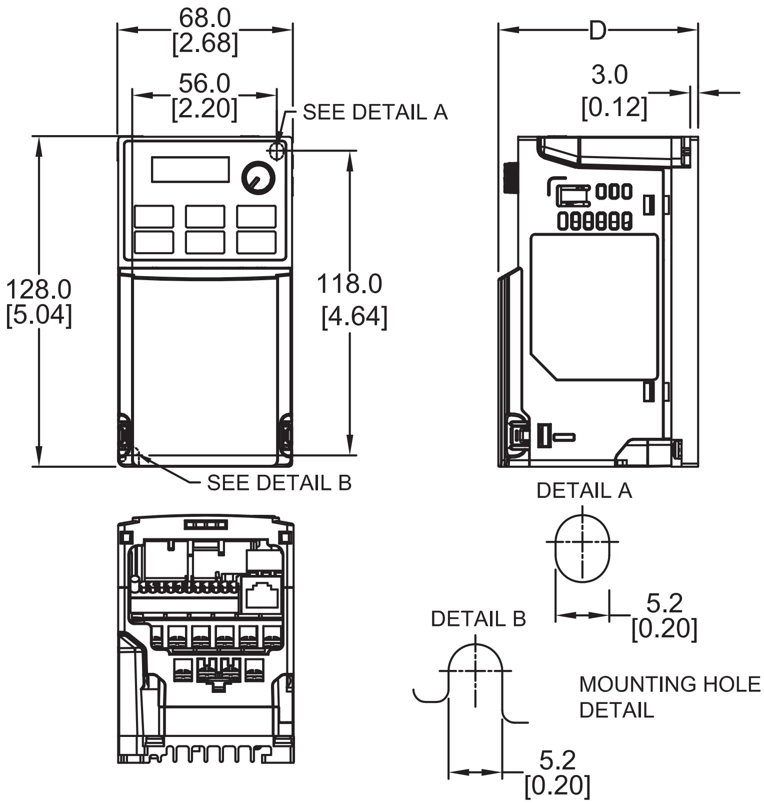
See our website: www.AutomationDirect.com for complete engineering drawings and 3D models.

GS10 DURApulse Frame Sizes by Drive Model					
115V		230V		460V	
Drive	Frame	Drive	Frame	Drive	Frame
GS11N-10P2	A1	GS11N-20P2	A1	GS13N-40P5	A4
GS11N-10P5	A3	GS11N-20P5	A3	GS13N-41P0	A6
GS11N-11P0	C1	GS11N-21P0	B2	GS13N-42P0	B1
		GS11N-22P0	C1	GS13N-43P0	C1
		GS11N-23P0	C1	GS13N-45P0	C1
		GS13N-20P2	A1	GS13N-47P5	D1
		GS13N-20P5	A2	GS13N-4010	D1
		GS13N-21P0	A5		
		GS13N-22P0	B1		
		GS13N-23P0	C1		
		GS13N-25P0	C1		
		GS13N-27P5	D1		

Dimensions (Units = mm [in])

See our website: www.AutomationDirect.com for complete engineering drawings and 3D models.

GS10 Frame Size A

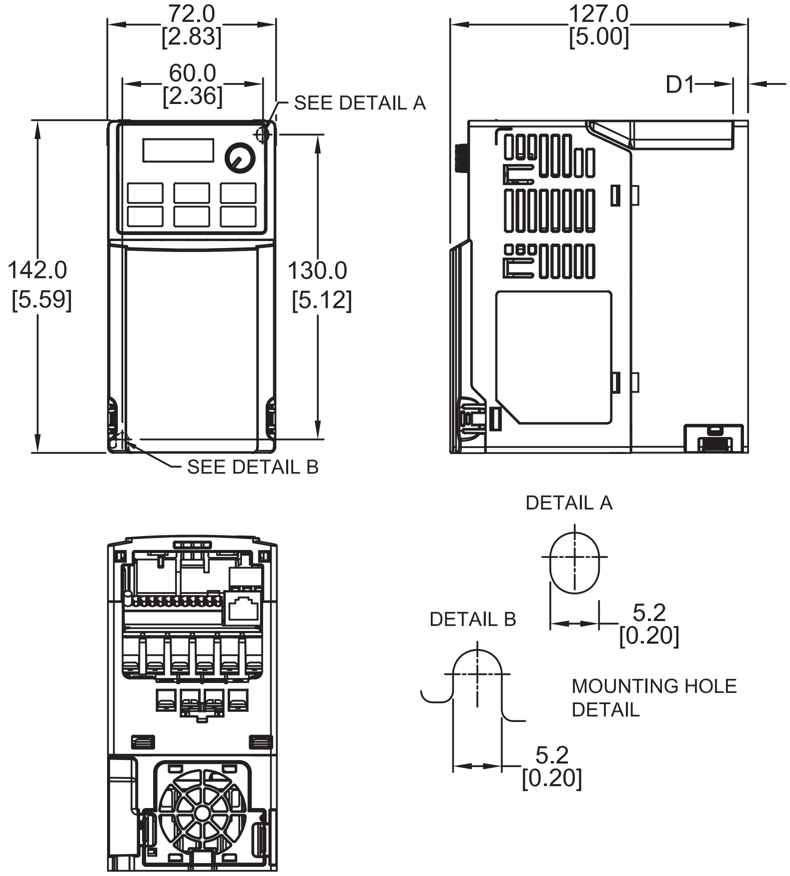


A Frame "D" Dimension	
Frame	**D mm [in]**
A1	78.0 [3.07]
A2	92.0 [3.62]
A3	107.0 [4.21]
A4	113.0 [4.45]
A5	125.0 [4.92]
A6	127.0 [5.00]

Dimensions (Units = mm [in])

See our website: www.AutomationDirect.com for complete engineering drawings and 3D models.

GS10 Frame Size B

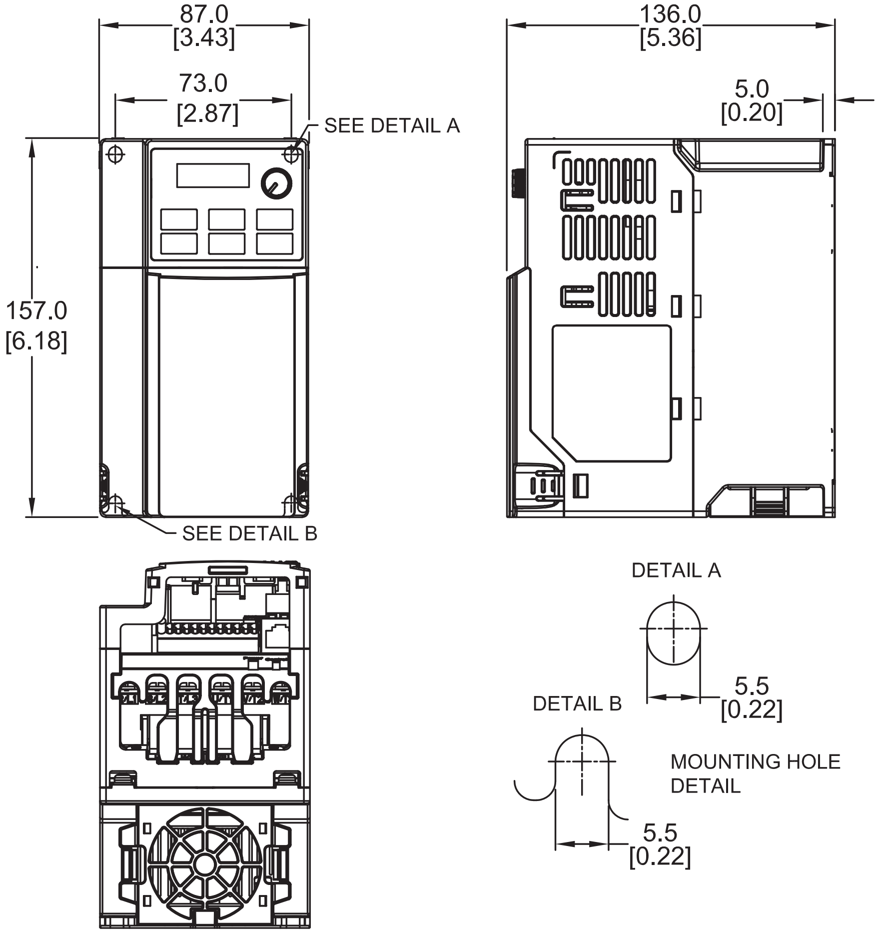


B Frame "D" & "D1"Dimensions		
Frame	D mm [in]	D1 mm [in]
B1	127.0 [5.00]	6.4 [0.25]
B2	127.0 [5.00]	3.0 [0.12]

Dimensions (Units = mm [in])

See our website: www.AutomationDirect.com for complete engineering drawings and 3D models.

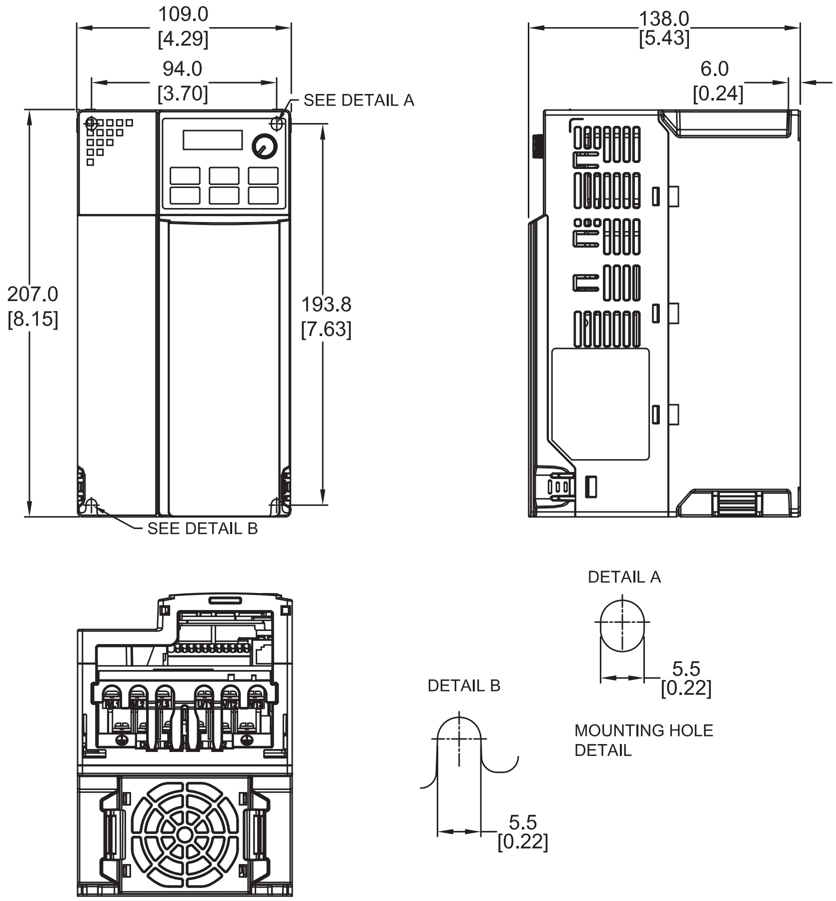
GS10 Frame Size C



Dimensions (Units = mm [in])

See our website: www.AutomationDirect.com for complete engineering drawings and 3D models.

GS10 Frame Size D



Circuit Connections – RFI Jumper

RFI Jumper: The GS10 drives may emit electrical noise. The drive contains Varistors / MOVs that are connected from phase to phase and from phase to ground to prevent the drive from unexpected stop or damage caused by mains surges or voltage spikes. Because the Varistors / MOVs from phase to ground are connected to ground with the RFI jumper, removing the RFI jumper disables the protection.

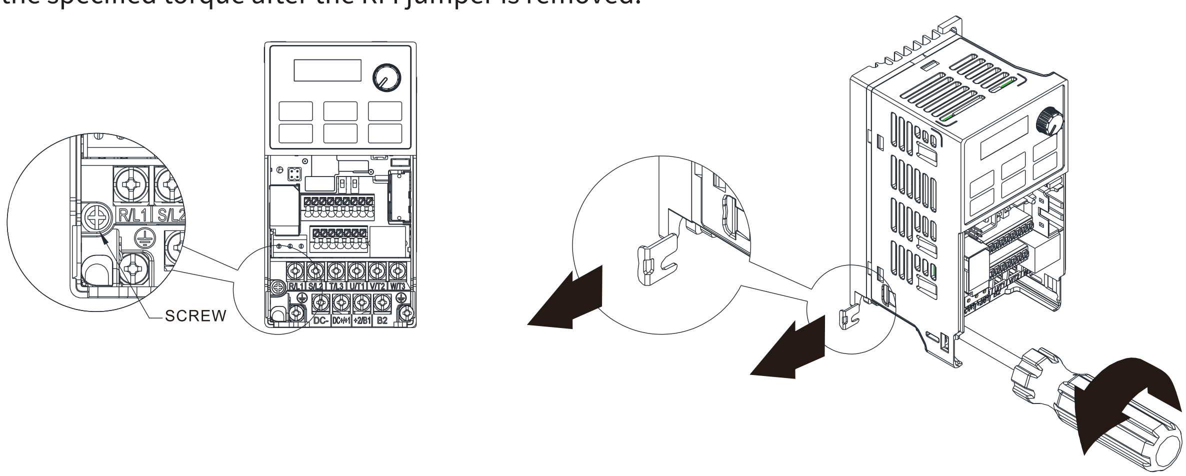
RFI Jumper Removal

The RFI jumper may need to be removed in some cases, such as situations in which the GS10 drive is powered from an Asymmetric Ground System (Corner Grounded TN System), as described on page 2–12.

GS10 Frames A~D

Screw Torque: 4~6 kg·cm [3.5~5.2 lb·in]

Loosen the screw indicated in the view below, and remove the RFI jumper. Tighten the screw to the specified torque after the RFI jumper is removed.



Isolating Main Power from Ground

WARNING: If the power distribution system supplying the GS10 drive is 120V single phase, the RFI jumper must be removed.

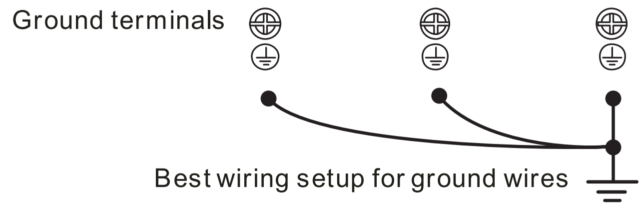
WARNING: If the power distribution system supplying the GS10 drive is a floating-ground system (IT) or an asymmetric-ground system (TN), the RFI jumper must be removed.

If the power distribution system supplying the GS10 drive is a floating ground system (IT) or an asymmetric ground system (TN), the RFI jumper must be removed. Removing the RFI jumper disconnects the internal RFI filter capacitor between the drive's frame and circuits to avoid damaging those circuits and to reduce ground leakage current.

Important points regarding ground connection

- *To ensure the safety of personnel, proper operation, and to reduce electromagnetic radiation, the GS10 drive must be properly grounded during installation.*
- *The diameter of the cables must meet the size specified by applicable codes and regulations.*
- *The shield of shielded cables must be connected to the ground of the GS10 drive to meet safety regulations.*
- *The shield of shielded cables can be used as the ground for equipment only when the aforementioned points are met.*

- *When installing multiple GS10 drives, do not connect the grounds of the AC motor drive in series. Instead, utilize a single-point grounding scheme (as shown below), or provide individual grounding rods for each GS10 drive.*



Pay particular attention to the following WARNINGS:

WARNING: Do not remove the RFI jumper while power is applied to the GS10 drive.

WARNING: For any 120V single phase input power drive, remove the RFI jumper.

WARNING: Cutting the RFI short-circuit cable will also cut off the conductivity of the capacitor. Gap discharge may occur once the transient voltage exceeds 1000V.

WARNING: The RFI jumper must NOT be removed if the main power is a symmetrically grounded power system.

WARNING: The RFI jumper must not be removed while conducting high voltage tests.

WARNING: When conducting a high voltage test to the entire facility, the main power and the motor must be disconnected if leakage current is too high.

Floating Ground System (IT Systems)

A floating ground system is also called an IT system, an ungrounded system, or a high impedance/resistance grounding system (greater than 30Ω).

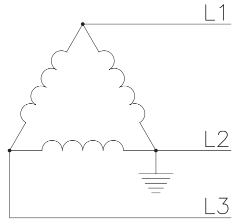
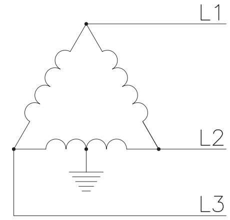
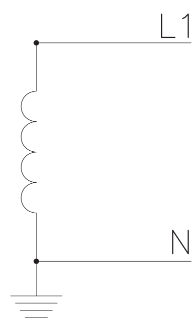
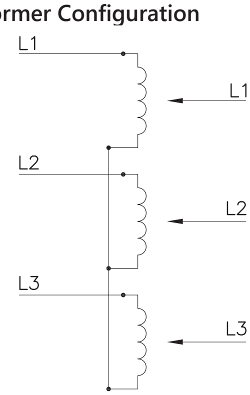
Disconnect the RFI Jumper

CAUTION: Do not install an external RFI/EMC filter! The EMC filter will pass through the RFI capacitor, thus connecting power input to ground. This is very dangerous and can easily damage the GS10 drive.

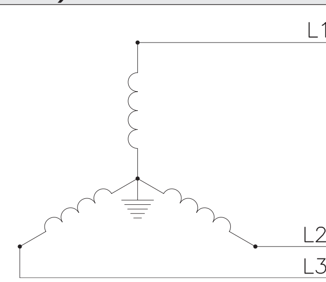
Asymmetric Ground System (Corner Grounded TN Systems)

CAUTION: Do not remove the RFI jumper while the input terminals of the GS10 drive carries power.

The RFI jumper must be removed in the following four situations. This is to prevent the system from grounding through the RFI capacitor, damaging the GS10 drive.

RFI Jumper Must Be Removed (Asymmetric Ground / Corner Grounded TN Systems)	
1) Grounding at a Corner of a Triangle Configuration 	2) Grounding at a Midpoint in a Polygonal Configuration 
3) Grounding at One End in a Single-Phase Configuration 	4) No Stable Neutral Grounding in a Three-Phase Autotransformer Configuration 

The RFI jumper should be left in place for a symmetrically grounded system.

RFI Jumper Left In Place (Symmetrical Ground System)	
Internal grounding through internal RFI filter, which reduces electromagnetic radiation. In a situation with higher requirements for electromagnetic compatibility, and using a symmetrical grounding power system, an EMC filter can be installed. As a reference, the diagram on the right is a symmetrical grounding power system.	

Circuit Connections – Warnings and Notes

Danger!

HAZARDOUS VOLTAGE! BEFORE MAKING ANY CONNECTION TO THE AC DRIVE, DISCONNECT ALL POWER TO THE AC DRIVE, AND WAIT FIVE MINUTES FOR DC BUS CAPACITORS TO DISCHARGE.

WARNING: ANY ELECTRICAL OR MECHANICAL MODIFICATION TO THIS EQUIPMENT WILL VOID ALL WARRANTIES, MAY RESULT IN A SAFETY HAZARD, AND MAY VOID THE UL LISTING.

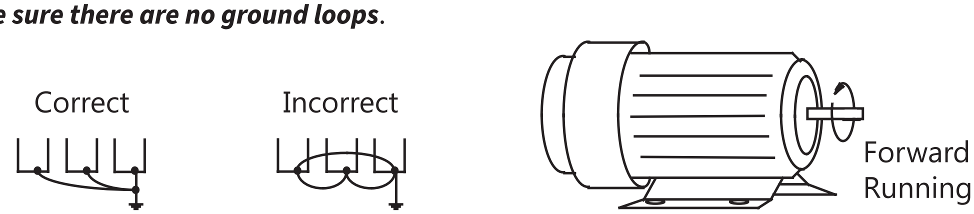
WARNING: DO NOT CONNECT THE AC INPUT POWER TO THE T1, T2, AND T3 OUTPUT TERMINALS. DOING THIS WILL DAMAGE THE AC DRIVE.

WARNING: DO NOT CONNECT SINGLE-PHASE POWER TO A 460V THREE-PHASE DRIVE MODEL.

WARNING: TIGHTEN ALL SCREWS TO THE PROPER TORQUE RATING. SEE "MAIN CIRCUIT WIRING" LATER IN THIS CHAPTER.

Wiring Notes: PLEASE READ PRIOR TO INSTALLATION.

1) During installation, follow all local electrical, construction, and safety codes for the country in which the AC drive is to be installed.
2) Refer to the "DURAPULSE GS10 Drive Specifications" in Chapter 1 for voltage and current requirements.
3) Torque the screws of the main circuit terminals to prevent loosening due to vibration.
4) The addition of a magnetic contactor (MC) in the AC line power input wiring is recommended to turn off power quickly and reduce the possibility of malfunction if the protection function of the GS10 AC drive is activated. Both ends of the MC should have an R-C surge absorber.
5) Do not use a power circuit contactor or disconnect switch for normal run/stop control of the GS10 AC drive and motor. This will reduce the operating life cycle of the AC drive. Cycling a power circuit switching device while the AC drive is in run mode should be done only in emergency situations.
6) Make sure the appropriate protective devices (circuit breaker or fuses) are connected between the power supply and AC drive.
7) Make sure that the leads are connected correctly and that the GS10 AC drive is properly grounded. (Ground resistance should not exceed 0.1Ω.)
8) Use ground leads that comply with AWG/MCM standards and keep them as short as possible.
9) Multiple GS10 AC drives can be installed in one location. All of the units should be grounded directly to a common ground terminal. The GS10 AC drive ground terminals may also be connected in parallel, as shown in the figure below.
   Make sure there are no ground loops.



10) When the GS10 AC drive output terminals T1, T2, and T3 are connected to the motor terminals T1, T2, and T3, respectively, the motor will rotate counterclockwise (as viewed from the shaft end of the motor) when a forward operation command is received. To reverse the direction of motor rotation, switch the connections of any of the two motor leads.
11) Make sure that the power source is capable of supplying the correct voltage and required current to the GS10 AC drive.
12) Do not attach or remove wiring when power is applied to the GS10 AC drive.
13) Do not inspect components unless inside "POWER" lamp is turned off.
14) Do not monitor the signals on the circuit board while the GS10 AC drive is in operation.
15) Route the power and control wires separately, or at 90 degree angle to each other.

16) Ground both ends of the shield wire or conduit for the power wiring.
a) If using a “VFD cable,” follow the manufacturer’s recommendation for grounding the cable shield.
b) If using conduit, bond and ground conduit according to applicable electrical codes.
17) If a filter is required for reducing EMI (Electro Magnetic Interference), install it as close as possible to the GS10 AC drive input. EMI can also be reduced by lowering the Carrier Frequency. Please refer to the “Applied EMI/RFI Techniques” white paper linked on the support resources section of the drive item page at www.automationdirect.com.
18) If the GS10 AC drive is installed in a place where a load reactor is needed, install the reactor close to the T1, T2, and T3 side of GS10 AC drive.
19) When using a GFCI (Ground Fault Circuit Interrupt), select current sensor with sensitivity of 200mA or higher, and not less than 0.1-second operation time to avoid nuisance tripping.

Main Power Terminals

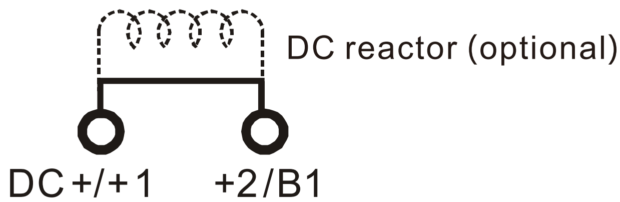
- *Do not supply GS10 460 VAC models with single-phase power. R/L1, S/L2, and T/L3 have no phase-sequence requirement; they can be wired in any order.*
- *Do NOT start/stop the GS10 AC drive by turning input power ON/OFF. Start/stop the GS10 AC drive using RUN/STOP commands via control terminals or the keypad. If you must start/stop the GS10 AC drive by turning power ON/OFF, it is recommended to do so only ONCE per hour.*

Output Terminals for Main Circuit

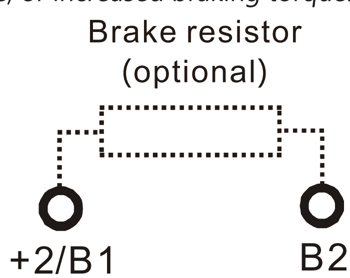
- *DO NOT connect phase-compensation capacitors or surge absorbers to the output terminals of the GS10 AC drive.*
- *Use a well-insulated motor suitable for inverter operation.*

Terminals for Connecting DC Reactor, External Brake Resistor, and DC Circuit

- *Terminals +1 and +2 are used to connect an optional DC reactor or choke to improve power factor. From the factory, these terminals are connected with a short-circuit jumper. Remove this jumper before connecting a DC reactor. Note that not all GS10 drives include terminal +1.*
- *Tighten the jumper if a DC reactor is not connected and DC+/+1 and +2/B1 terminals are used for common DC bus or brake resistors. This will prevent the AC motor drive from losing power and damage to the terminals. If the jumper is missing due to wiring, refer to the recommended main circuit terminal wire to short-circuit the DC+/+1 and +2/B1 terminals.*



- *When the GS10 AC Drive is connected directly to a large-capacity power transformer (600kVA or above) or when a phase lead capacitor is switched, peak currents may occur in the power input circuit due to the load change, resulting in damage to the converter section of the drive. To avoid this damage install a line reactor at the GS10 input terminals, R/L1, S/L2, and T/L3. The installation of a line reactor will reduce current and improve input power efficiency.*
- *Install an external brake resistor for applications in frequent deceleration to stop, short deceleration time (such as high frequency operation and heavy load operation), too low braking torque, or increased braking torque.*



- *For GS10 drives, the external brake resistor should be connected to the B1 and B2 terminals.*
- *If the terminals [+1], [+2], and [DC-] are not used, leave these three terminals open.*
- *To avoid personal injury and to prevent damage to the GS10 drive; DO NOT jumper DC- to DC+, DC- to +2/B1, DC- to B2. Connect braking resistors to B1 and B2 ONLY*
- *DC+ and DC- are connected for common DC bus, please refer to "Main Circuit Wiring Terminals" in this chapter for wiring terminal specification and wire gauge information.*
- *Please refer to the DURApulse Drives Dynamic Braking User Manual for more information on installing brake resistors.*
  (Available for free download at https://cdn.automationdirect.com/static/manuals/gs3dbm/gs-db_ump.pdf)

Motor Operation Precautions

1) When using the GS10 AC drive to operate an older standard 3-phase induction motor, the energy loss will be greater than with a modern inverter duty motor.
2) Running an ac induction motor at low speed can cause the motor temperature to exceed the motor rating due to limited airflow produced by the motor's fan. If running at low speeds, a high performance inverter duty motor is recommended.
3) If **100% output torque** is desired at low speed, it may be necessary to use a special **"high performance inverter-duty" motor**.

Short Circuit Withstand (SCCR)

All *DURApulse* GS10 series drives are suitable for use on a circuit capable of delivering not more than 100,000 rms symmetrical amperes.

Applicable Codes

All *DURApulse GS10* AC drives are Underwriters Laboratories, Inc. (UL) and Canadian Underwriters Laboratories (cUL) listed, and therefore comply with the requirements of the National Electrical Code (NEC) and the Canadian Electrical Code (CEC).

Installations intended to meet the UL and cUL requirements must follow the instructions provided in “Wiring Notes” as a minimum standard. Follow all local codes that exceed UL and cUL requirements. Refer to the technical data label affixed to the AC drive and the motor nameplate for electrical data.

The “Circuit Protection Devices” section in Appendix A lists the recommended fuse part number for each *DURApulse* part number. These fuses (or equivalent) must be used on all installations where compliance with U.L. standards is required.

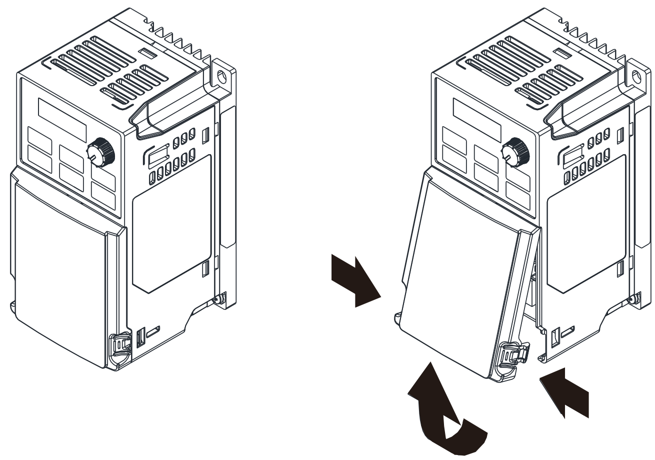
Wiring Terminal Access

Control Terminal Access

Remove the drive front cover to access and wire the multi-function input/output control terminals.

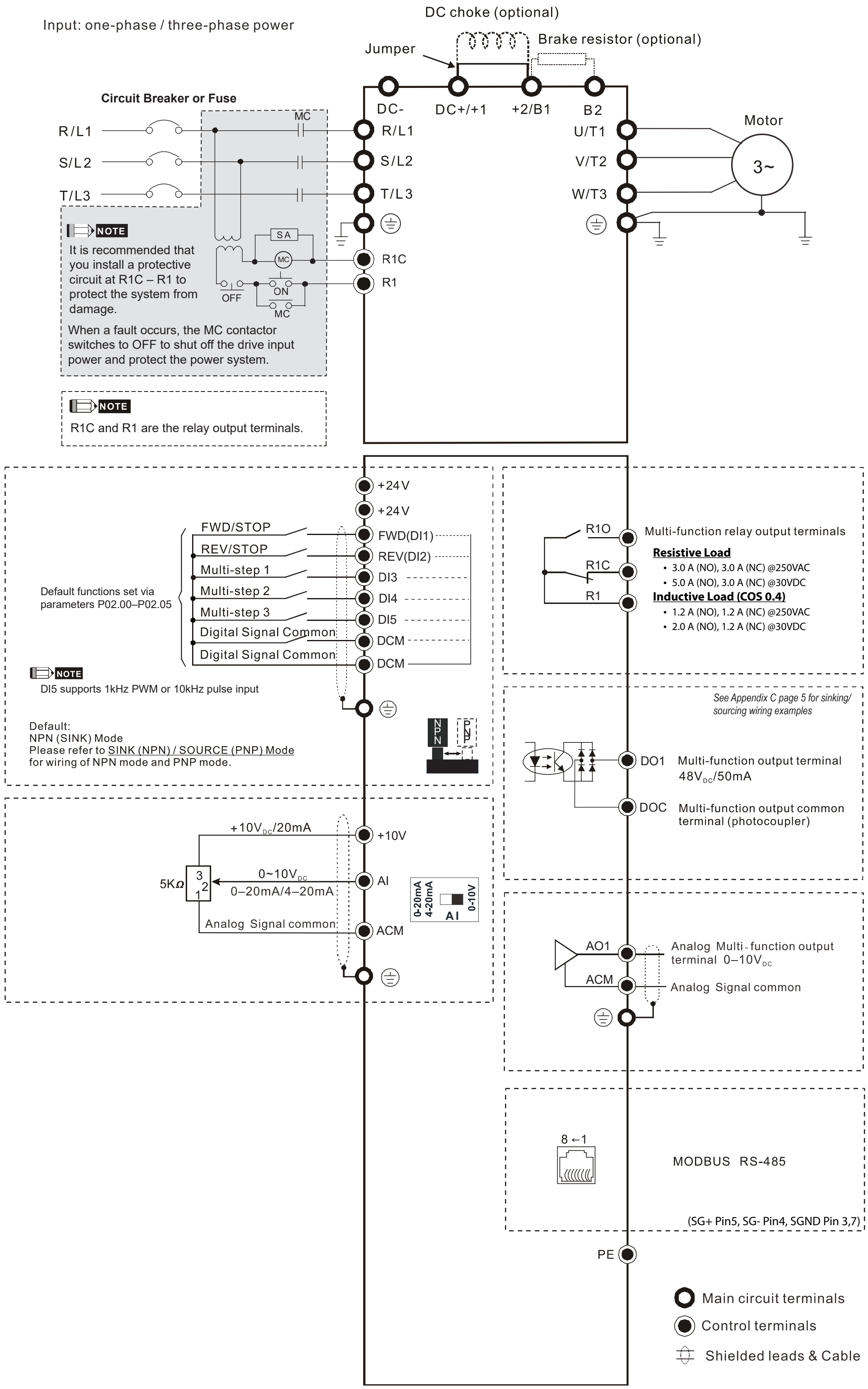
GS10 Drive Frames A ~ D

Press the tabs on both sides to remove the cover.



GS10 Wiring Diagrams and Terminals

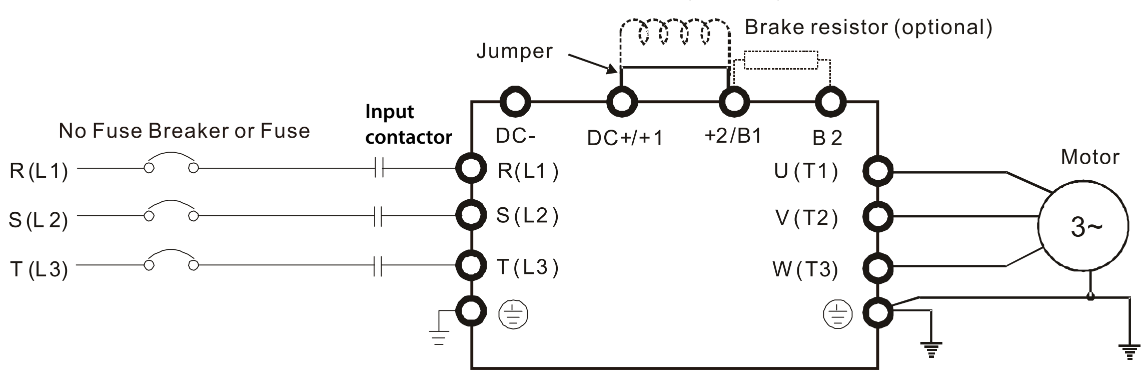
Full I/O Wiring Diagram



Main Circuit Wiring Diagram

GS10 All Frame Sizes

Input 1-phase/3-phase power



Main Circuit Terminals	
Terminal	**Description**
R/L1, S/L2	Input Power – phase 1
R/L1, S/L2, T/L3	Input Power – phase 3
U/T1, V/T2, W/T3	AC Motor Drive Output
+1, +2	Connection for DC reactor (remove jumper before installing a DC reactor)
B1, B2	Braking Resistor Connection (optional)
DC+, DC-	Common DC Bus
⏚	Ground

NOTE: 120VAC models do not have DC bus terminals DC-, DC+/+1

Main Circuit Wiring Terminals

Main Terminal Specifications

GS10 Main Circuit Wiring Specifications							
AC Drive Frame Size	***AC Drive Model***	***Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, DC-, DC+/+1, +2/B1, B2***			***Ground Terminals ⏚***		
		Max Wire Gauge	***Min Wire Gauge***	***Screw Size & Torque (±10%)***	***Max Wire Gauge***	***Min Wire Gauge***	***Screw Size & Torque (±10%)***
A	***GS11N-10P2***	2.5 mm^2 [14 AWG]	2.5 mm^2 [14 AWG]	M3.5 9 kg-cm [7.8 in-lb] [0.88 N·m]	2.5 mm^2 [14 AWG]	2.5 mm^2 [14 AWG]	M3.5 9 kg-cm [7.8 in-lb] [0.88 N·m]
	GS11N-10P5						
	GS11N-20P2						
	GS11N-20P5		1.5 mm^2 [16 AWG]				
	GS13N-20P2		0.75 mm^2 [18 AWG]				
	GS13N-20P5						
	GS13N-21P0		1.5 mm^2 [16 AWG]				
	GS13N-40P5		0.75 mm^2 [18 AWG]				
	GS13N-41P0						
B	***GS11N-21P0***	4 mm^2 [12 AWG]	4 mm^2 [12 AWG]	M4 15 kg-cm [13.0 in-lb] [1.47 N·m]	4 mm^2 [12 AWG]	4 mm^2 [12 AWG]	M4 15 kg-cm [13.0 in-lb] [1.47 N·m]
	GS13N-22P0						
	GS13N-42P0		2.5 mm^2 [14 AWG]		2.5 mm^2 [14 AWG]	2.5 mm^2 [14 AWG]	
C	***GS11N-11P0***	10 mm^2 [8 AWG]	10 mm^2 [8 AWG]	M4 20 kg-cm [17.4 in-lb] [1.96 N·m]	10 mm^2 [8 AWG]	10 mm^2 [8 AWG]	M4 20 kg-cm [17.4 in-lb] [1.96 N·m]
	GS11N-22P0						
	GS11N-23P0						
	GS13N-23P0		6 mm^2 [10 AWG]		6 mm^2 [10 AWG]	6 mm^2 [10 AWG]	
	GS13N-25P0		10 mm^2 [8 AWG]		10 mm^2 [8 AWG]	10 mm^2 [8 AWG]	
	GS13N-43P0		2.5 mm^2 [14 AWG]		2.5 mm^2 [14 AWG]	2.5 mm^2 [14 AWG]	
	GS13N-45P0		4 mm^2 [12 AWG]		4 mm^2 [12 AWG]	4 mm^2 [12 AWG]	
D	***GS13N-27P5***	10 mm^2 [8 AWG]	10 mm^2 [8 AWG]	M4 20 kg-cm [17.4 in-lb] [1.96 N·m]	10 mm^2 [8 AWG]	10 mm^2 [8 AWG]	M4 20 kg-cm [17.4 in-lb] [1.96 N·m]
	GS13N-47P5		6 mm^2 [10 AWG]		6 mm^2 [10 AWG]	6 mm^2 [10 AWG]	
	GS13N-4010		10 mm^2 [8 AWG]		10 mm^2 [8 AWG]	10 mm^2 [8 AWG]	

UL installations must use 600V, 75°C or 90°C wires. Use copper wire only.

Wiring Terminal Connector Dimensions – Main-Circuit Terminals

Dimensions = mm

GS10 Drives, Frame Size A ~ D

NOTE: Heat shrink should comply with UL (600V, YDPU2).

Power Terminal Wiring Connectors:

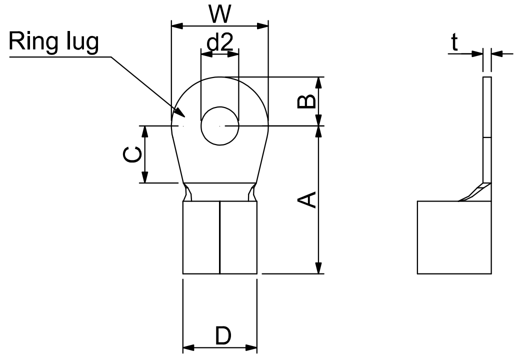


Figure 1.

Heat Shrink Tubing:

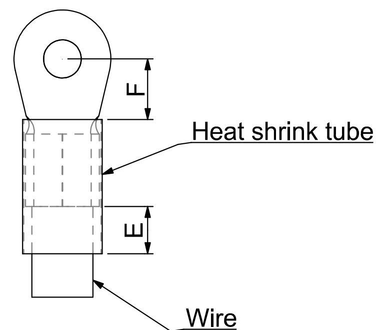


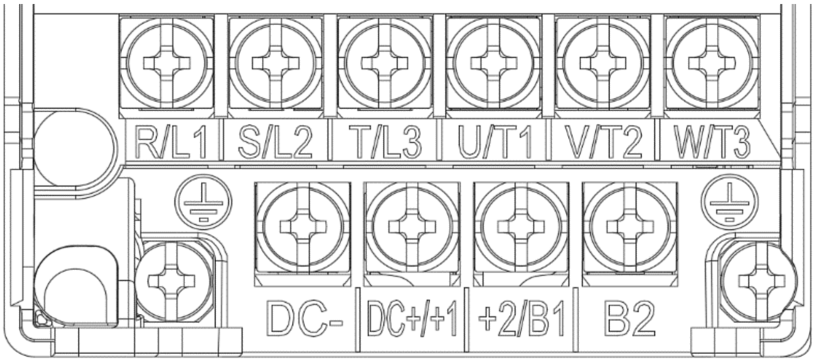
Figure 2.

GS10 Ring Lug Dimensions (mm)											
Frame	***AWG***	***Part Number (Manuf: K.S. Terminals)***	***A (Max)***	***B (Max)***	***C (Min)***	***D (Max)***	***d2 (Min)***	***E (Min)***	***F (Min)***	***W (Max)***	***t (Max)***
A	***18***	RNBS 1.3.7	9.8	3.2	4.8	4.1	3.7	13.0	4.2	6.6	0.8
	16	RNBS 2-3.7									
	14	RNBS 2-3.7									
B	***18***	RNBS1-4	12.1	3.6	6.1	5.6	4.3	13.0	4.5	7.2	1
	16	RNBS1-4									
	14	RNBS2-4									
	12	RNBS5-4									
C	***14***	RNBS2-4	17.8	5.0	6.1	7.2	4.3	13.0	5.5	10.5	1.2
	12	RNBS5-4									
	10	RNBS5-4									
	8	RNBS8-4									
D	***10***	RNBS5-4	17.8	5.0	6.1	7.2	4.3	13.0	5.5	10.5	1.2
	8	RNBS8-4									

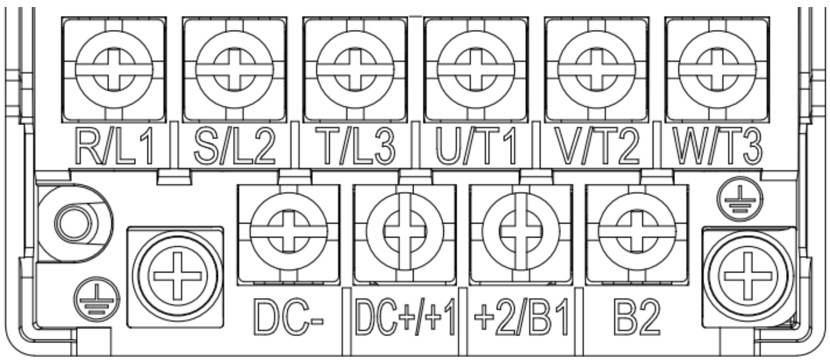
Main Terminal Diagrams

NOTE: 120VAC models do not have DC bus terminals DC-, DC+/+1

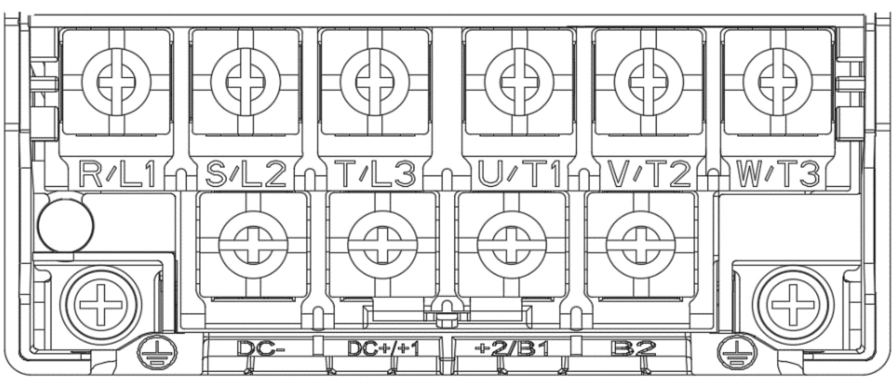
GS10 Frame Size A Main Terminals



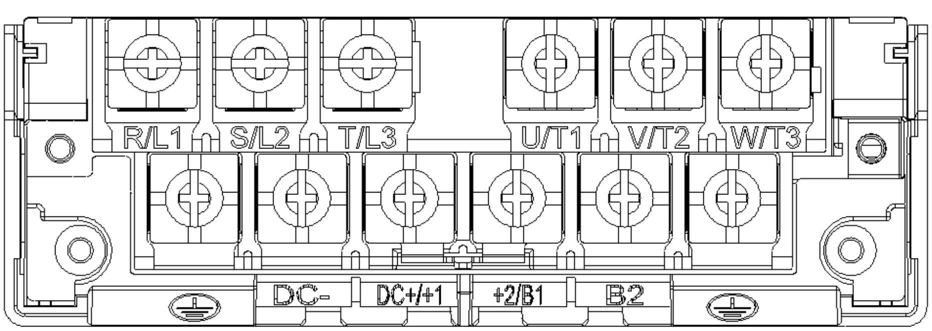
GS10 Frame Size B Main Terminals



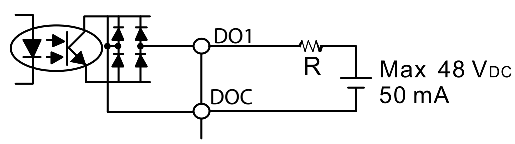
GS10 Frame Size C Main Terminals



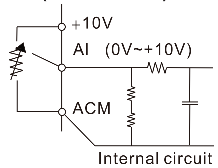
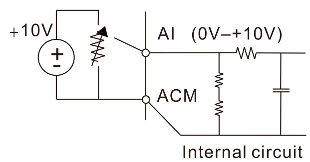
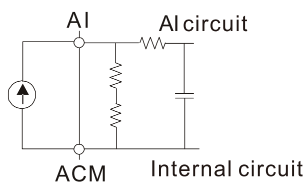
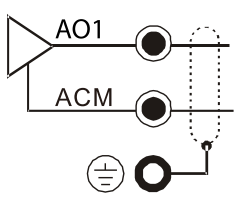
GS10 Frame Size D Main Terminals



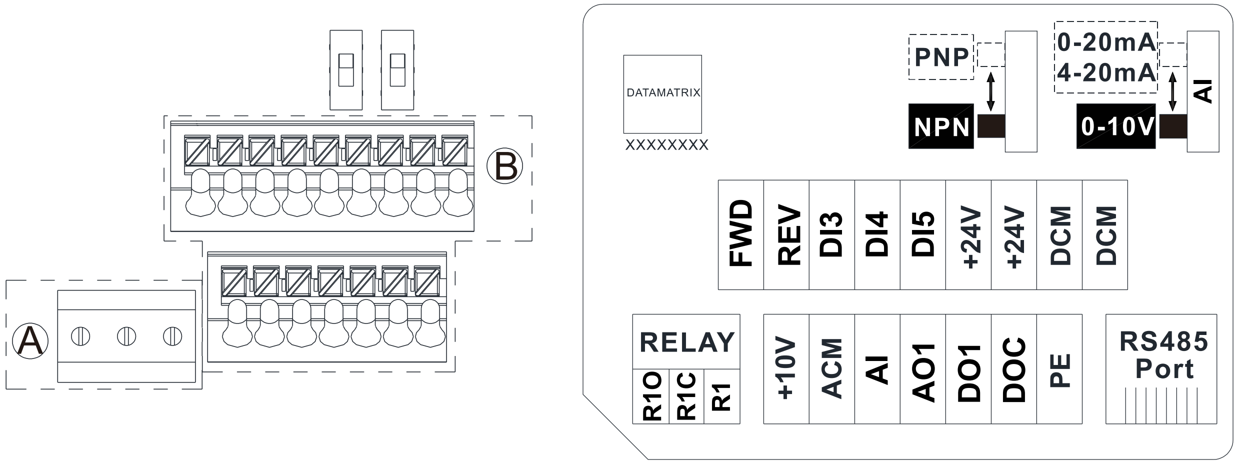
GS10 Control Terminal Specifications

Control Circuit Terminals		
Terminal Symbol	***Terminal Function***	***Description***
+24V	Digital control signal common (Source)	+24V ± 10% 100 mA
DCM	Digital control / Frequency signal common (Sink)	Digital control common.
FWD (DI1) REV (DI2) DI3 - DI5	Digital input 1–5	Refer to P02.00–02.05 to program the digital inputs FWD (DI1), REV (DI2), DI3–DI5. **Source Mode:** ON: activation current 3.3 mA ≥ 11 VDC OFF: cut-off voltage ≤ 5 VDC **Sink Mode:** ON: activation current 3.3 mA ≤ 13 VDC OFF: cut-off voltage ≥ 19 VDC • When P02.00=0, FWD (DI1) and REV (DI2) can be programmed. • When P02.00≠0, the functions of FWD (DI1) and REV (DI2) act according to P02.00 setting. • When P02.05=0, DI5 is pulse input terminal. • When P00.20 = 4, DI5 is the speed command source. • When DI5 uses single pulse input, the maximum input frequency=10kHz. • When DI5 uses PWM pulse input, the maximum input frequency=1kHz. • Refer to P10.16 for DI5 pulse configuration.
DO1	Digital Output 1 (photo coupler)	The AC motor drive outputs various monitoring signals through a transistor (open collector). Refer to P2.16 to program the output. 
DOC	Digital Output Common (photo coupler)	
R1O	Relay Output 1 (N.O.)	The AC motor drive outputs various monitoring signals through a relay output. Refer to P2.13 to program the output. **Resistive Load** • 3.0 A (NO), 3.0 A (NC) @ 250VAC • 5.0 A (NO), 3.0 A (NC) @ 30VDC **Inductive Load (COS 0.4)** • 1.2 A (NO), 1.2 A (NC) @ 250VAC • 2.0 A (NO), 1.2 A (NC) @ 30VDC
R1C	Relay Output 1 (N.C.)	
R1	Relay Output 1 Common	
+10V	Potentiometer power supply	Power supply for analog frequency setting: +10.5 ± 0.5 VDC / 20 mA

(continued next page)

Control Circuit Terminals (continued)		
Terminal Symbol	***Terminal Function***	***Description***
AI	Analog voltage frequency command **AI-V Mode** **AI-V Mode (Potentiometer)**  **AI-V Mode (voltage input)**  **AI-C Mode** 	The AI default is 0–10 V (AI-V, voltage mode). To switch to the current mode, two steps are required: 1) A dip switch must be configured (follow the instructions on the inner side of the front cover or see page 2–xx) 2) Change P03.28 to 1 (0mA) or 2 (4mA) Use P03.00 to program AI functionality for Voltage or Current mode. AI resolution=12 bits **Voltage (AI-V) mode** • Impedance: 20 kΩ • Range 0–Max. Output Frequency (P01.00): 0 to 10 V • P03.28 = 0 **Current (AI-C) mode** • Impedance: 250 Ω • Range 0– Maximum Output Frequency (P01.00): 0–20 mA/4–20 mA • Range switching according to P03.28 = 1 (0mA) or 2 (4mA)
AO1	Multi-function analog voltage output 	AO1 outputs an analog voltage signal based on P03.20. • Range: 0–10 V (P03.21=0) corresponds to the maximum operating range of the control target • Max. output current: 2 mA • Max. Load: 5 kΩ • AO1 resolution=12 bits
ACM	Analog Signal Common	Analog signal common terminal
PE	RS485	The PE terminal is for shielded cable to ground to decrease interference when you use RS485 communication.
RJ45	PIN 1, 2, 6: Reserved PIN 3, 7: SGND PIN 4: SG- PIN 5: SG+ PIN 8: +10V power for optional GS4-KPD	The RJ45 port provides serial communications connection. Max Baud Rate = 38.4 kbps

Control Terminal Block Diagram & Wiring Specifications

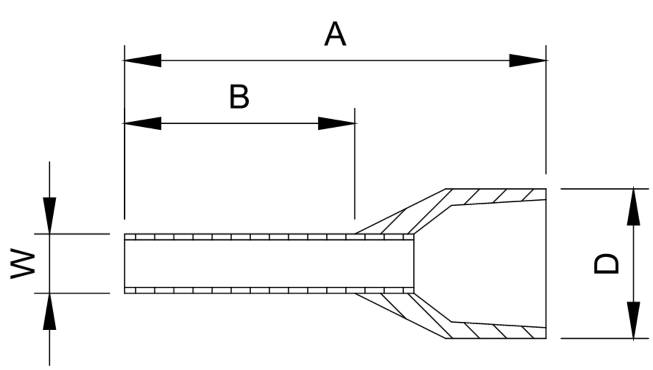


A = Relay terminal, PCB terminal block
B = Control terminal, spring clamp terminal block.

Wiring Specifications					
Terminal	***Wiring Type***	***Stripping Length (mm)***	***Maximum Wire Guage***	***Minimum Wire Gauge***	***Tightening Torque***
Relay	**Solid**	**9-10**	1.5 mm2 (16 AWG)	0.25 mm2 (24 AWG)	5 kg·cm [4.3 lb·in] [0.49 N·m]
	Strand				
Control	**Solid**	**9**	0.75 mm2 (18 AWG)	0.25 mm2 (24 AWG)	n/a (spring terminals)
	Strand				
	Stranded with ferrules with plastic sleeves		0.5 mm2 (20 AWG)		

Recommended models or dimensions for ferrule terminals

Wire Gauge	Manufacturer	Model Name	A (MAX)	B (MAX)	D (MAX)	W (MAX)
0.25 mm2 [24 AWG]	PHOENIX CONTACT	AI 0,25- 8 YE	12.5	8	2.6	1.1
0.34 mm2 [22 AWG]	PHOENIX CONTACT	AI 0,34- 8 TQ	12.5	8	3.3	1.3
0.5 mm2 [20 AWG]	PHOENIX CONTACT	AI 0,5 - 8 WH	14	8	3.5	1.4
	Z+F	V30AE000006	14	8	2.6	1.15



Control Terminal Wiring Instructions

Digital Inputs

- *When using contacts or switches to control the digital inputs, use high quality components to avoid contact bounce.*

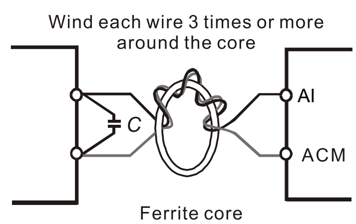
Wiring Multiple Drives Together – Digital Inputs

- *With drive Digital Inputs in SINKING mode: When connecting a single device to the Digital Inputs of multiple drives (Run, Stop, Reverse, etc.), the DCM (Digital Signal Common) terminals from each drive should be connected together. [Otherwise, do NOT connect the different drive DCM terminals together if the drive DI are sourcing.]*
- *With drive Digital Inputs in SOURCING mode (and the connected field devices are sinking): DO NOT connect the different drive DCM terminals together. [If the DCM terminals of multiple drives are connected together with the drive DI in sourcing mode, the inputs of some of the drives may inadvertently turn ON if another drive is powered OFF.]*
  Example: A switch is tied to Digital Input 1 of Drives A, B, C, and D. The Drive inputs are all set to Source current out to the field devices.   If Drives A, B and C lose power, their Digital Inputs may sink enough current to inadvertently turn ON Digital Input 1 on Drive D.

WARNING: With drive Digital Inputs in SOURCING mode
Do NOT connect the different drive DCM terminals together.

Analog Inputs

- *Analog input signals are easily affected by external noise. Use shielded wiring and keep it as short as possible (<20m) with proper grounding. If the noise is inductive, connect the shield to terminal ACM.*
- *Use twisted-pair wire*
- *If the analog input signals are affected by noise from the AC motor drive, please connect a capacitor and ferrite core as indicated in the diagram at right.*
  (Wind each wire around the core 3 times or more.)



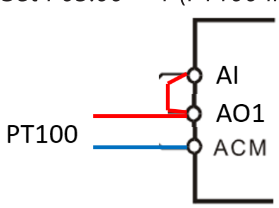
Transistor Outputs (DO1, DOC)

- *Make sure to connect the digital outputs to the correct polarity.*
- *When connecting a relay to the digital outputs, connect a surge absorber across the coil and check the polarity.*

PT100 RTD

PT100 RTD circuits should be wired and configured as follows:

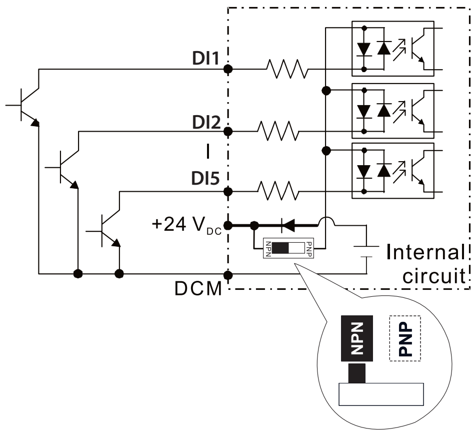
- *Set P03.00 = 1 (PT100 input)*



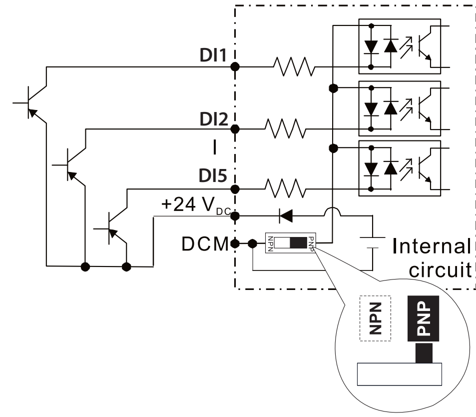
Control Circuit Wiring Diagrams

Digital Inputs

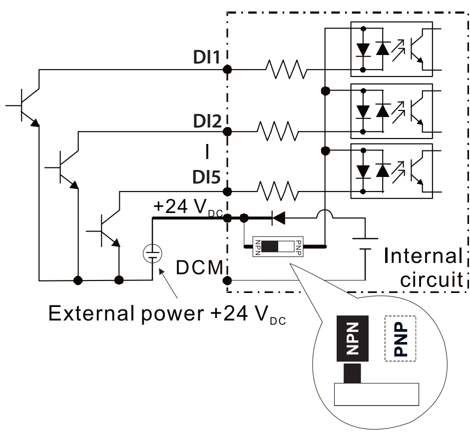
① Sink Mode
with internal power (+24 V_{DC})



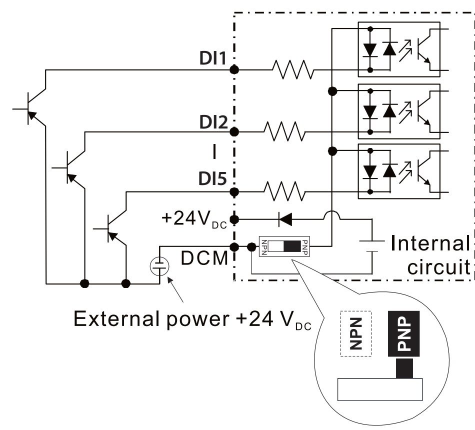
② Source Mode
with internal power (+24 V_{DC})



③ Sink Mode
with external power

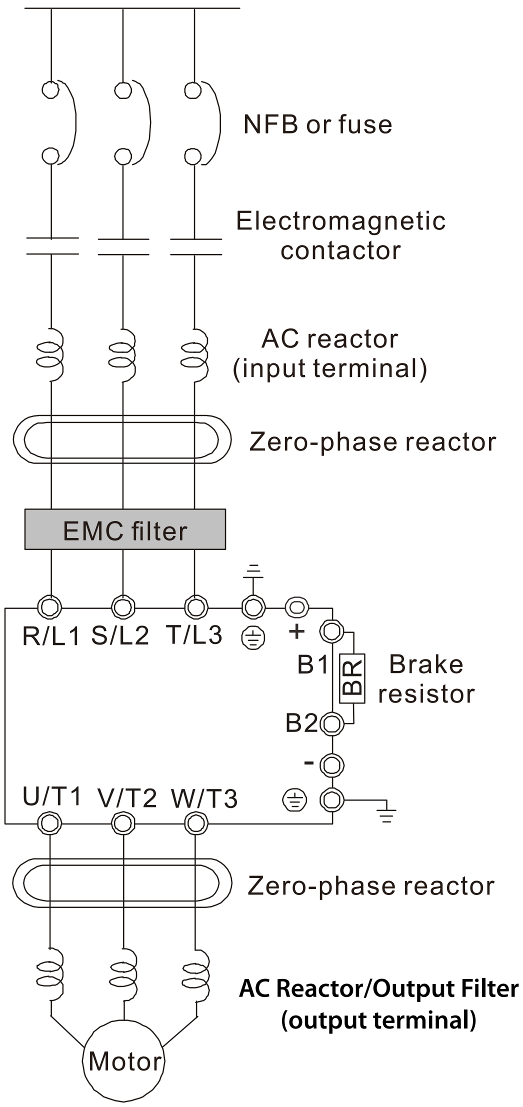


④ Source Mode
with external power



Control Circuit Wiring Diagrams (continued)

System Wiring Diagram



System Wiring Components	
Component	***Function***
Power input terminal	Supply power according to the rated power specifications indicated in the manual
NFB or fuse	There may be a large inrush current during power on. Select a suitable NFB (Non Fuse Breaker or Circuit Breaker) or Fuse.
Electromagnetic contactor	Switching the power ON/OFF on the primary side of the electromagnetic contactor can turn the drive ON/OFF, but frequent switching can cause machine failure. Do not switch ON/OFF more than once an hour. Do not use the electromagnetic contactor as the power switch for the drive; doing so shortens the life of the drive.
AC reactor (input terminal)	When the main power supply capacity is greater than 500 kVA, or when it switches into the phase capacitor, the instantaneous peak voltage and current generated may destroy the internal circuit of the drive. It is recommended that you install an input side AC reactor in the drive. This also improves the power factor and reduces power harmonics. The wiring distance should be within 10 m.
Zero phase reactor	Used to reduce radiated interference, especially in environments with audio devices, and reduce input and output side interference. The effective range is AM band to 10 MHz.
EMC filter	Can be used to reduce electromagnetic interference.
Brake module and Brake resistor (BR)	Used to shorten the deceleration time of the motor.
AC reactor (output terminal)	The motor cable length affects the size of the reflected wave on the motor end.

Keypad Operation and Quick-Start

Chapter 3

Table of Contents

The DURApulse GS10 Digital Keypad

The GS10 drives come with a digital keypad equipped with six buttons and a potentiometer. You can use the digital keypad to control the drive, set parameters, change drive modes, etc. For more detailed control options, you can use GSoft2 software by connecting to a computer via USB (see Chapter 7).

It is also possible to use the GS4-KPD with the GS10 for expanded keypad functionality. For more about using the GS4-KPD, please see “Optional Advanced Keypad” on page A–37.

GS10 Digital Keypad

Descriptions of Keypad Functions	
RUN	**RUN Key** • Valid only when the source of operation command is from the keypad. • RUN can be pressed even when drive is in process of stopping. • When in “LOCAL” mode, RUN is valid only when the source of operation command is from the keypad.
STOP RESET	**STOP/RESET Key** *This key has the highest processing priority in any situation.* • When the drive receives a STOP command, whether the drive is in operation or stop status, the drive will execute a "STOP" command. • The RESET key can be used to reset the drive after a fault occurs. For those faults that can't be reset by the RESET key, see the fault records after pressing MENU key for details. *NOTE: The ability to STOP the drive from the keypad is effective ONLY if the drive is configured to RUN and/or STOP from the keypad. Keypad STOP can be disabled by parameter 00.32, Digital Keypad STOP Function.*
ENTER	**ENTER Key** Press ENTER to go to the next menu level or accept parameter entry. If it is the last level, then press ENTER to execute the command.
MENU	**MENU Key** Press MENU to return to the Main Menu or cycle through the available menu options.
▲	**Direction: Up** Press to make the value set on the current menu/parameter higher.
◀/▼	**Direction: Left/Down** • Press to make the value set on the current menu/parameter lower. • In the menu/text selection mode, the arrows are used for item selection. Long press the MENU key to use the left direction function.
	Frequency Setting Dial (Potentiometer) The dial can be set as the main frequency input. Set Parameter 00-20 or 00-30 to equal ‘7-Digital Keypad Dial’.

Keypad Indicator LEDs

The left and right sides of the digital display contain a series of LEDs that light up to indicate certain drive functions.

Descriptions of LED Functions	
RUN	**Steady ON**: Drive is running. **Blinking**: Drive is stopping or in base block. **Steady OFF**: Drive is not running.
FWD	**Steady ON**: Drive is operating in Forward mode. **Blinking**: Drive is changing direction. **Steady OFF**: Drive is operating in Reverse mode.
REV	**Steady ON**: Drive is operating in Reverse mode. **Blinking**: Drive is changing direction. **Steady OFF**: Drive is operating in Forward mode.
STOP	**Steady ON**: Drive is stopped or in the process of stopping. **Blinking**: Drive is in standby (run but does not output). **Steady OFF**: Drive is not currently executing an operational (STOP) command. *NOTE: The ability to STOP the drive from the keypad is effective ONLY if the drive is configured to RUN and/or STOP from the keypad. Keypad STOP can be disabled by parameter 00.32, Digital Keypad STOP Function.*

GS10 Keypad Operation

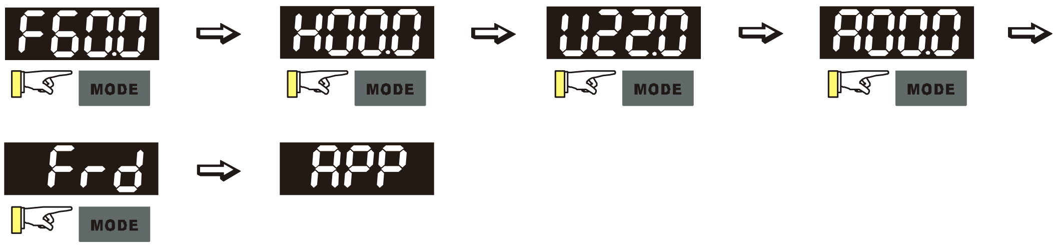
The following section details digital keypad operation for the GS10 series drives.

GS10 Keypad Function Examples

Instruction	*Press Key*	*Display Will Show*	
First menu to display after power up.	n/a	Displays the present frequency setting of the drive	RUN ● FWD ● REV ● F60.0 ● STOP
Press MENU once from startup.	MENU	Displays the actual output frequency of the drive	RUN ● FWD ● REV ● H50.0 ● STOP
Press MENU twice from startup.	MENU	Displays user defined output	RUN ● FWD ● REV ● U 18 ● STOP
Press MENU three times from startup.	MENU	Displays output current	RUN ● FWD ● REV ● A 5.0 ● STOP
Press MENU four times from startup. Displays Frd if the drive is currently configured for Forward operation. Press the UP or DOWN key to change to Reverse. Press ENTER to confirm the change.	MENU, UP/ DOWN ENTER	Displays the Forward command if configured for Forward operation.	RUN ● FWD ● REV ● Frd ● STOP
		Displays the Reverse command if configured for Reverse operation.	RUN ● FWD ● REV ● rEu ● STOP
Enable the counter by setting parameter 00.04 to 1. See the user manual for full instructions on using the counter.	MENU	Displays the counter value	RUN ● FWD ● REV ● c 20 ● STOP
After selecting the desired menu option, press ENTER to bring up the parameter number (Format XX.YY). Use the UP and DOWN arrow keys to change the parameter number as needed, then press ENTER to adjust the parameter value.	ENTER, UP/ DOWN, ENTER	Displays the parameter number	RUN ● FWD ● REV ● 06.00 ● STOP
From the parameter number screen, press ENTER to bring up the current value of the selected parameter. Use the UP and DOWN arrows to adjust the value. Press ENTER again to confirm the choice.	ENTER, UP/ DOWN	Displays the value of the selected parameter	RUN ● FWD ● REV ● 10 ● STOP
Once a desired parameter value has been set using the UP and DOWN arrow keys, press ENTER to save the choice and display End message.	ENTER	End message. Displays when data has been accepted and stored	RUN ● FWD ● REV ● End ● STOP
Displays when an external fault is detected.	n/a	External fault message	RUN ● FWD ● REV ● EF ● STOP
Displays when data is not accepted or the value exceeded	n/a	Error message.	RUN ● FWD ● REV ● Err ● STOP

Main Page

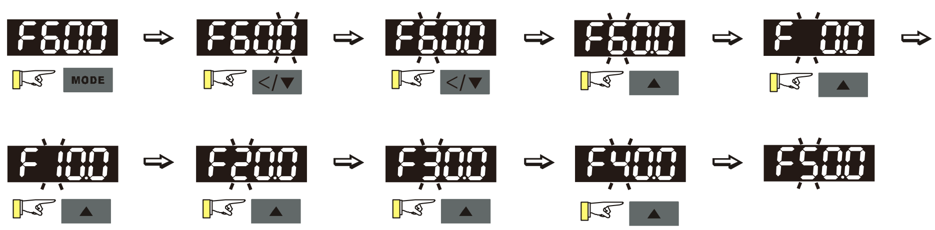
When the drive first starts up, it will display the present frequency setting of the drive. To access the other main pages of the keypad, press the MENU button to cycle through the options.



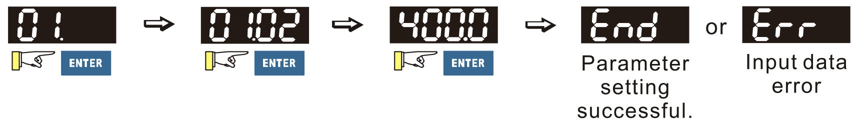
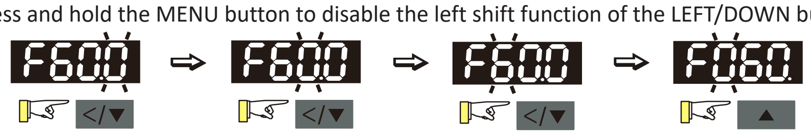
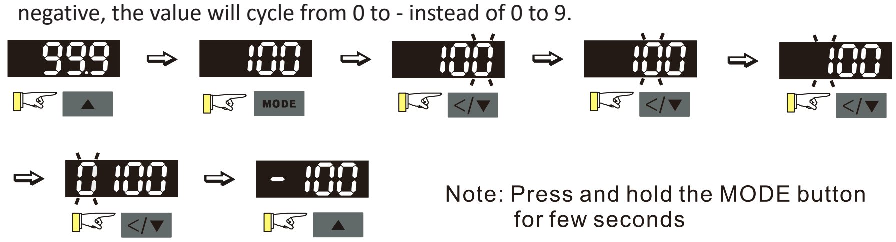
NOTE: In screen selection mode, press ENTER to set the parameters.

NOTE: APP only displays when parameter 13.00 does not equal 0.

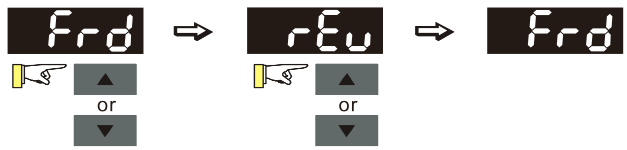
Frequency Command Settings

Frequency Command Instructions	
Change Frequency Setting	The default maximum frequency setting (parameter 01.00) is 60.0 Hz. The command frequency on the drive can not be set higher than the maximum frequency value. To set the command frequency value, follow the instructions below: 1) Press the MENU key until F60.0 is displayed (see “Parameter Settings” on page 3–6.). 2) Hold down MENU until the final digit of the value begins to blink. 3) Press the LEFT/DOWN button to select the digits you wish to change. Press the UP button to cycle through the values available. 4) Press and hold MENU until no digits are blinking.  Note: To change the value to something greater than 99.9, follow the steps above but press the LEFT/DOWN button until the left-most digit (normally blank) switches to a blinking 0. Then use the UP button to change to the desired value. The maximum frequency value is 599.0. If a higher value is chosen, the parameter screen will display Err, followed by 599.0 (the maximum possible), then revert to the previous good value.

Parameter Settings

Parameter Setting Instructions	
Setting Parameters	1) Press MENU until the parameter screen appears (typically H 0.0). 2) Press ENTER to switch to the parameter group, then press the UP button to select the desired group number. 3) Press ENTER to switch to the parameter number, then press the UP button to select the desired number. 4) Press ENTER to switch to the parameter value, then press the UP or LEFT/DOWN button to cycle through the available options. 5) Press ENTER. If END displays, the parameter was successfully updated. If Err displays, the chosen configuration is not viable.  **Note:** When working with Parameters, the leading digit on the GS10 display will toggle between a "P" and the parameter number. For example, parameter P04.01 will alternate between "P4.01" and "04.01".
Unsigned Parameter Settings	To set an unsigned parameter value, follow the steps for "Setting Parameters" above, until you reach the parameter value. Then: 1) Press and hold the MENU button until the last digit of the parameter value begins to blink. 2) Change the value by pressing the UP button. 3) Press the LEFT/DOWN button to move to the next digit, and change its value using the UP button. Repeat the process until all digits have been configured as desired. 4) Press and hold the MENU button to disable the left shift function of the LEFT/DOWN button. 
Setting a negative parameter value	Follow the normal steps for setting a parameter as above. To set the parameter value to negative: 1) Press and hold the MENU button while on the parameter value until the final digit begins to blink. 2) Use the LEFT/DOWN button to navigate all the way to the left of the screen. 3) Use the UP button to cycle through the available digits. For parameters cable of being set to negative, the value will cycle from 0 to - instead of 0 to 9.  For parameter values with three digits and two decimal places and a positive/negative setting, the keypad only displays three digits (-100, not -100.0).

Setting Direction

<table>
<tr><th colspan="2">Setting Direction Instructions</th></tr>
<tr><td>Setting to Forward or Reverse Mode</td><td>The GS10 drive can be configured to run in forward (Frd) or reverse (rEu) mode. To set the drive direction:
1) From the startup screen, press the MENU button until Frd or rEu appears.
2) Press the UP or LEFT/DOWN button to cycle through the options. The option is selected as soon as it displays.
3) Press MENU to return to the other screens.

</td></tr>
</table>

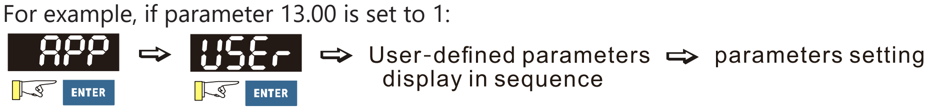
Application Settings

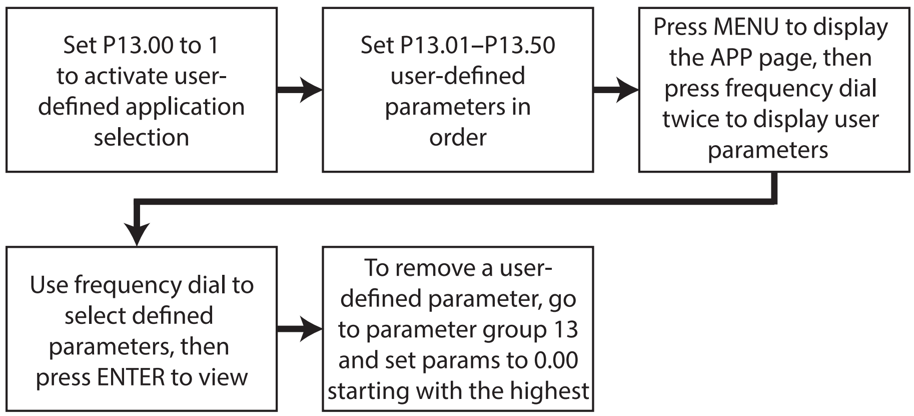
The APP setting can be used to provide a shortcut to application specific parameters for easier access through the keypad. The application selection page does not display unless parameter 13.00 is set to a value other than zero. By default, parameter 13.00 is set to 0.

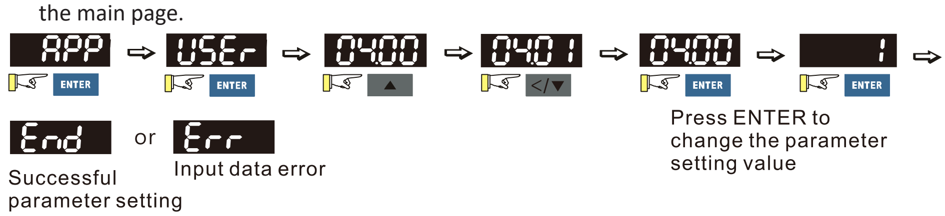
<table>
<tr><th colspan="2">Application Settings Instructions</th></tr>
<tr><td>Enabling the APP keypad screen</td><td>To enable the APP keypad screen, set parameter 13.00 to a value other than 0. Use the instructions under “Setting Parameters”on the previous page to navigate to parameter 13.00 and set a value.

The following options are available:
<table>
<tr><th>Value</th><th>Keypad Display</th><th>Description</th></tr>
<tr><td>0</td><td>n/a</td><td>APP is off and does not display.</td></tr>
<tr><td>1</td><td>USEr</td><td>User-defined application.</td></tr>
<tr><td>3</td><td>FAn</td><td>Fan application</td></tr>
<tr><td>4</td><td>PUNP</td><td>Pump application</td></tr>
<tr><td>5</td><td>CnYr</td><td>Conveyer application</td></tr>
<tr><td>7</td><td>PAC</td><td>Packing application</td></tr>
<tr><td>10</td><td>LoG</td><td>Logistics</td></tr>
<tr><td>11</td><td>P1d</td><td>Tension PID</td></tr>
<tr><td>12</td><td>P1dA</td><td>Tension PID + master/auxiliary frequency</td></tr>
</table></td></tr>
<tr><td>Using the APP setting</td><td>To verify the current APP setting of the drive, press the MENU button until APP appears, then press ENTER to display the current APP setting. If APP does not appear, parameter 13.00 is set to 0 and APP is disabled.

If APP is enabled, press ENTER again to access a list of application appropriate parameters. Use the UP and LEFT/DOWN keys to view parameter numbers. Press the ENTER key to select a parameter, then modify per the standard parameter setting instructions.

For example, if parameter 13.00 is set to 1:

</td></tr>
</table>

<table>
<tr><th colspan="2">Application Settings Instructions</th></tr>
<tr><td>Configuring the User-defined Parameter Set</td><td>
The user-defined APP setting (USEr) allows you to configure your own list of parameters for quick access. Up to 50 parameters can be set by configuring parameters 13.01–13.50.
1) Navigate to the parameter settings and set P13.00 to 1.
2) Next, select the parameter you wish to set a definition for, P13.01 through P13.50 are available. User-defined parameters must use parameter 13.xx in sequence or an Err will occur. The first user-defined parameter must be under 13.01, the second under 13.02, etc. If you wish to remove user-defined parameters, they must also be removed in order, starting with the highest 13.xx configured and working down.
3) Press and hold the MENU button until the last digit of the value (default will be 0.00) blinks, then use the UP and LEFT/DOWN buttons to set the parameter number you wish to reference. Note that you cannot set values for read-only parameters.
4) Press ENTER to accept.
5) Repeat as needed using parameters 13.02 and up until all desired parameters are referenced.
6) When you’ve finished setting parameters, press the MENU button to go back to the APP page and press the frequency setting dial. The keypad will display USER. Press it again and the corresponding parameter that you set appears.


Note: When working with Parameters, the leading digit on the GS10 display will toggle between a “P” and the parameter number. For example, parameter P04.01 will alternate between “P4.01” and “04.01”.
</td></tr>
<tr><td>Modifying User-defined Parameter Set Values</td><td>
The APP page can be used to modify the values of parameters in the user-defined parameter set rather than needing to go to the parameter page. To modify the value of a parameter in the user-defined set, follow the steps below:
1) Press MENU until APP appears, then press ENTER.
2) When USEr displays, press ENTER to bring up the list of user-defined parameters.
3) Use the UP and LEFT/DOWN buttons to select the desired parameter, then press ENTER.
4) Use the UP and LEFT/DOWN buttons to select the desired parameter value, then press ENTER.
5) If the value is valid, End will display. If it is not valid, Err will display. Press MENU to return to the main page.


Note: When working with Parameters, the leading digit on the GS10 display will toggle between a “P” and the parameter number. For example, parameter P04.01 will alternate between “P4.01” and “04.01”.
</td></tr>
</table>

Reference Table for Digital LED Character Display

The table below shows how characters display on the LED screen with the number or letter represented above it. This can helpful for characters such as “V” that do not display normally on the LED.

Number	0	1	2	3	4	5	6	7	8	9
Display	0	1	2	3	4	5	6	7	8	9
Number	A	a	B	b	C	c	D	d	E	e
Display	A	-	-	b	C	c	-	d	E	-
Number	F	f	G	g	H	h	I	i	J	j
Display	F	-	G	-	H	h	-	i	J	j
Number	K	k	L	l	M	m	N	n	O	o
Display	K	-	L	-	-	-	-	n	-	o
Number	P	p	Q	q	R	r	S	s	T	t
Display	P	-	-	q	-	r	S	-	-	t
Number	U	u	V	v	W	w	X	x	Y	y
Display	U	u	-	v	-	-	-	-	y	-
Number	Z	z								
Display	Z	-								

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PAGE

AC Drive Parameters

Chapter 4

Table of Contents

Chapter 4: AC Drive Parameters

Introduction

This chapter covers all the parameters available for use with the GS10 series drives. The first section provides a summary of the parameters and some basic information. The second section provides detailed information about each parameter.

Video Tutorials

Video tutorials for the GS10 family of drives are located here:

- www.automationdirect.com/videos *(random search)*
- www.automationdirect.com/cookbook *(organized by subject/topic)*

DURApulse GS10 Parameter Summary

Drive Parameters Summary (P00.xx)

For detailed information about the P0.xx parameter group, please refer to page 4–47.

GS10 Parameters Summary – Drive Parameters (P00.xx)							
Parameter		***Range***	***Run[1] Read/ Write***	***Modbus Address***		***Settings***	
				Hex	***Dec***	***Default[2]***	***User***
1) ♦ in the Run-Read/Write column indicates that the parameter can be set during RUN mode. R/W indicates "Read/Write." Read indicates "Read-only." 2) Parameters can be restored to their default values using P00.02.							
P00.00	GS10 Model ID-Identity Code	102: 120 V, 1 Phase, 0.25 HP 103: 120 V, 1 Phase, 0.5 HP 104: 120 V, 1 Phase, 1 HP 302: 230 V, 1 Phase, 0.25 HP 303: 230 V, 1 Phase, 0.5 HP 304: 230 V, 1 Phase, 1 HP 305: 230 V, 1 Phase, 2 HP 306: 230 V, 1 Phase, 3 HP 202: 230 V, 3 Phase, 0.25 HP 203: 230 V, 3 Phase, 0.5 HP 204: 230 V, 3 Phase, 1 HP 205: 230 V, 3 Phase, 2 HP 206: 230 V, 3 Phase, 3 HP 207: 230 V, 3 Phase, 5 HP 208: 230 V, 3 Phase, 7.5 HP 403: 460 V, 3 Phase, 0.5 HP 404: 460 V, 3 Phase, 1 HP 405: 460 V, 3 Phase, 2 HP 406: 460 V, 3 Phase, 3 HP 407: 460 V, 3 Phase, 5 HP 408: 460 V, 3 Phase, 7.5 HP 409: 460 V, 3 Phase, 10 HP	Read	0000	40001	~	
P00.01	Rated Current	Display by models	Read	0001	40002	~	
P00.02	Restore to Default	0: No function 1: Parameter Lock 5: Reset kWh Display to 0 8: Disable Keypad Run 9: Reset all parameters to 50Hz defaults 10: Reset all parameters to 60Hz defaults 11: Reset all parameters to 50Hz defaults (retain user-defined parameter values P13.01~P13.50) 12: Reset all parameters to 60Hz defaults (retain user-defined parameter values P13.01~P13.50) ***Note:*** Reboot drive after resetting defaults.	R/W	0002	40003	0	
(table continued next page)							

GS10 Parameters Summary – Drive Parameters (P00.xx) – (continued)							
Parameter		**Range**	**Run* Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P00.03	Start-up display Selection	0: F – Freq Setpoint 1: H – Output Hz 2: U - User Display (P00.04) 3: A – Output Amps	♦R/W	0003	40004	0	
P00.04	User Display	0: Output Amps (A) (unit: Amp) 1: Counter Value (c) (unit: CNT) 2: Output Frequency (H.) (unit: Hz) 3: DC Bus Voltage (V) (unit: VDC) 4: Output Voltage (E) (unit: VAC) 5: Power Factor (n) (unit: deg) 6: Output Power (P) (unit: kW) 7: Calculated RPM (r) (unit: rpm) 8: Output Torque (t.) (unit: %) 10: PID Feedback (b) (unit: %) 11: AI-V Analog Input Signal (1.) (unit: %) 12: AI-C Analog Input Signal (2.) (unit: %) 14: IGBT Temperature (i.) (unit: °C) 16: DI Input Status (ON / OFF) (i) 17: DO Output Status (ON / OFF) (o) 18: Multi-Speed Step (S) 19: CPU DI Input Status (d) 20: CPU DO Output Status (0.) 25: Overload count (0.00–100.00%) (o.) (unit: %) 26: Ground fault GFF (G.) (unit: %) 27: DC bus voltage ripple (r.) (unit: VDC) 30: Display the output of User-defined (U) 31: Display P00.05 user gain (K) 36: Present operating carrier frequency of the drive (J.) (Unit: Hz) 38: Display the drive status (6.) 41: kWh display (J) (unit: kWh) 42: PID target value (h.) (unit: %) 43: PID compensation (o.) (unit: %) 44: PID output frequency (b.) (unit: Hz) 46: Aux frequency value (U.) (unit: Hz) 47: Master frequency value (A) (unit: Hz) 48: Frequency value after addition and subtraction of master and auxiliary frequency (L.) (unit: Hz) 60: Display PID setting and feedback signal (0:) 61: Display the content of the running program (1=tt)(0)	♦R/W	0004	40005	3	
P00.05	Coefficient Gain in Actual Output Frequency Display (H Page scale)	0.00–160.00	♦R/W	0005	40006	1.00	
P00.06	Firmware version	Read only	Read	0006	40007	~	
P00.07	Parameter protection password input	0–65535 0–4: the number of password attempts allowed	♦R/W	0007	40008	0	
P00.08	Parameter protection password setting	0–65535 0: No password protection or password entered correctly (P00-07) 1: Parameter has been set	♦R/W	0008	40009	0	
P00.10	Control Method	0: Speed Control mode	R/W	000A	40011	0	

(table continued next page)

GS10 Parameters Summary – Drive Parameters (P00.xx) – (continued)							
Parameter		**Range**	**Run* Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P00.11	Speed (Velocity) Control mode	0: IMVF (V/F control) 2: IM/PM SVC (IM or PM space vector control) **Note:** For option 2 (SVC), see P05.33 for induction motor (IM) or permanent magnet (PM) motor selection.	R/W	000B	40012	0	
P00.16	Torque duty selection	0: Variable Torque (VT) 1: Constant Torque (CT)	R/W	0010	40017	1	
P00.17	Carrier frequency	Variable Torque: 2–15 kHz Constant Torque: 2–15 kHz	R/W	0011	40018	4	
P00.18	GS Series Number	10: GS10 series drive (GS11N or GS13N) 20: GS20 series drive (GS21 or GS23) 21: GS20X series drive (GS21X or GS23X)	Read	0012	40019	–	
P00.20	Master frequency command source (AUTO, REMOTE)	0: Digital keypad 1: RS-485 communication input 2: External analog input (Refer to P03.00) 3: External UP / DOWN terminal (digital input terminals) 4: Pulse input (DI5) without direction command (refer to P10.16 for pulse input config) 7: Digital keypad VR/potentiometer dial 9: PID controller (with P08.65=1) **Note**: Auto is Default control mode. HOA (Hand-Off-Auto) function is valid only when you use with digital input (DI) function setting 42 or 56 or with GS4-KPD (optional).	♦R/W	0014	40021	0	
P00.21	Operation command source (AUTO, REMOTE)	0: Digital keypad 1: External terminals 2: RS-485 communication input **Note:** Auto is Default control mode. HOA (Hand-Off-Auto) function is valid only when you use with digital input (DI) function setting 42 or 56 or with GS4-KPD (optional).	♦R/W	0015	40022	0	
P00.22	Stop method	0: Ramp to stop 1: Coast to stop 2: Motor stops by simple positioning	♦R/W	0016	40023	0	
P00.23	Motor direction control	0: Enable forward / reverse 1: Disable reverse 2: Disable forward	♦R/W	0017	40024	0	
P00.24	Digital operator (keypad) frequency command memory	Read only	Read	0018	40025	60	

(table continued next page)

GS10 Parameters Summary – Drive Parameters (P00.xx) – (continued)							
Parameter		Range	Run* Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P00.25	User-defined characteristics (COEFF ATT)	bit 0–3: user-defined decimal places 0000h, 0000b: no decimal place 0001h, 0001b: one decimal place 0002h, 0010b: two decimal places 0003h, 0011b: three decimal places bit 4–15: user-defined unit 000xh: Hz 001xh: rpm 002xh: % 003xh: kg 004xh: m/s 005xh: kW 006xh: HP 007xh: ppm 008xh: 1/m 009xh: kg/s 00Axh: kg/m 00Bxh: kg/h 00Cxh: lb/s 00Dxh: lb/m 00Exh: lb/h 00Fxh: ft/s 010xh: ft/m 011xh: m 012xh: ft 013xh: degC 014xh: degF 015xh: mbar 016xh: bar 017xh: Pa 018xh: kPa 019xh: mWG 01Axh: inWG 01Bxh: ftWG 01Cxh: psi 01Dxh: atm 01Exh: L/s 01Fxh: L/m 020xh: L/h 021xh: m3/s 022xh: m3/h 023xh: GPM 024xh: CFM	♦R/W	0019	40026	0	
P00.26	User-defined maximum value (COEFF MAX)	0: Disable 0–65535 (when P00.25 is set to no decimal place) 0.0–6553.5 (when P00.25 is set to one decimal place) 0.00–655.35 (when P00.25 is set to two decimal places) 0.000–65.535 (when P00.25 is set to three decimal places)	RW	001A	40027	0	
P00.27	User-defined value (COEFF SET)	Read only	Read	001B	40028	0	

(table continued next page)

GS10 Parameters Summary – Drive Parameters (P00.xx) – (continued)							
Parameter		**Range**	**Run* Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P00.29	LOCAL / REMOTE selection	0: Standard HOA function 1: When switching between local and remote, the drive stops. 2: When switching between local and remote, the drive runs with REMOTE settings for frequency and operating status. 3: When switching between local and remote, the drive runs with LOCAL settings for frequency and operating status. 4: When switching between local and remote, the drive runs with LOCAL settings when switched to Local and runs with REMOTE settings when switched to Remote for frequency and operating status.	R/W	001D	40030	4	
P00.30	Master frequency command source (HAND, LOCAL)	0: Digital keypad 1: RS-485 communication input 2: External analog input (refer to P03.00) 3: External UP / DOWN terminal (digital input terminals) 4: Pulse input (DI5) without direction command (refer to P10.16 for pulse input config) 7: Digital keypad VR/potentiometer dial 9: PID controller **Note:** HOA (Hand-Off-Auto) function is valid only when you use with digital input (DI) function setting 41 or 56 or with GS4-KPD (optional).	♦R/W	001E	40031	0	
P00.31	Operation command source (HAND, LOCAL)	0: Digital keypad 1: External terminal 2: RS-485 communication input **Note:** HOA (Hand-Off-Auto) function is valid only when you use with digital input (DI) function setting 41 or 56 or with GS4-KPD (optional).	♦R/W	001F	40032	0	
P00.32	Digital keypad STOP function	0: STOP key disabled 1: STOP key enabled	♦R/W	0020	40033	0	
P00.33	RPWM Range	0: Disabled 1: RPWM mode 1 2: RPWM mode 2 3: RPWM mode 3	♦R/W	0021	40034	0	
P00.34	Auxiliary Frequency Source	0.0–4.0 kHz P00.17 = 4kHz, 8kHz: the setting range is 0.0–2.0 kHz P00.17 = 5–7 kHz: the setting range is 0.0–4.0 kHz	♦R/W	0022	40035	0.0	
P00.35	Auxiliary frequency source	0: Master and auxiliary frequency function disabled 1: Digital keypad 2: RS-485 communication input 3: Analog input 4: External UP / DOWN key input (digital input terminals) 7: Digital keypad VR/potentiometer dial	R/W	0023	40036	0	

(table continued next page)

GS10 Parameters Summary – Drive Parameters (P00.xx) – (continued)							
Parameter		**Range**	**Run* Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P00.36	Master and auxiliary frequency command selection	0: Master + auxiliary frequency 1: Master - auxiliary frequency 2: Auxiliary - master frequency	R/W	0024	40037	0	
P00.48	Display filter time (current)	0.001–65.535 sec.	♦R/W	0030	40049	0.100	
P00.49	Display filter time (keypad)	0.001–65.535 sec.	♦R/W	0031	40050	0.100	
P00.50	Date Code of Firmware version (date)	Read only	Read	0032	40051	0	

Basic Parameters Summary (P01.xx)

For detailed information about the P01.xx parameter group, please refer to page 4–64.

GS10 Parameters Summary – Basic Parameters (P01.xx)							
Parameter		Range	Run[1] Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default[2]	User
1) ♦ in the Run-Read/Write column indicates that the parameter can be set during RUN mode. R/W indicates "Read/Write." Read indicates "Read-only." 2) Parameters can be restored to their default values using P00.02.							
P01.00	Maximum operation frequency	0.00–599.0 Hz	R/W	0100	40257	60.00 / 50.00	
P01.01	Motor 1 Fbase	0.00–599.0 Hz	R/W	0101	40258	60.00 / 50.00	
P01.02	Motor 1, Rated Voltage (Nameplate)	120V / 230V models: 0.0–255.0 V 460V models: 0.0–510.0 V	R/W	0102	40259	220.0 440.0	
P01.03	Motor 1, Mid-point frequency 1	0.00–599.0 Hz	R/W	0103	40260	3.00	
P01.04	Motor 1, Mid-point voltage 1	120V / 230V models: 0.0–240.0 V 460V models: 0.0–480.0 V	♦R/W	0104	40261	11.0 22.0	
P01.05	Motor 1, Mid-point frequency 2	0.00–599.0 Hz	R/W	0105	40262	1.50	
P01.06	Motor 1, Mid-point voltage 2	120V / 230V models: 0.0–240.0 V 460V models: 0.0–480.0 V	♦R/W	0106	40263	5.0 10.0	
P01.07	Motor 1, Minimum output frequency	0.00–599.0 Hz	R/W	0107	40264	0.50	
P01.08	Motor 1, Minimum output voltage	120V / 230V models: 0.0–240.0 V 460V models: 0.0–480.0 V	♦R/W	0108	40265	1.0 2.0	
P01.09	Start-up frequency	0.00–599.0 Hz	R/W	0109	40266	0.50	
P01.10	Output frequency upper limit	0.00–599.0 Hz	♦R/W	010A	40267	599.0	
P01.11	Output frequency lower limit	0.00–599.0 Hz	♦R/W	010B	40268	0.00	
P01.12	Acceleration time 1	P01.45 = 0: 0.00–600.0 sec. P01.45 = 1: 0.0–6000 sec.	♦R/W	010C	40269	10.00 10.0	
P01.13	Deceleration time 1	P01.45 = 0: 0.00–600.0 sec. P01.45 = 1: 0.0–6000 sec.	♦R/W	010D	40270	10.00 10.0	
P01.14	Acceleration time 2	P01.45 = 0: 0.00–600.0 sec. P01.45 = 1: 0.0–6000 sec.	♦R/W	010E	40271	10.00 10.0	
P01.15	Deceleration time 2	P01.45 = 0: 0.00–600.0 sec. P01.45 = 1: 0.0–6000 sec.	♦R/W	010F	40272	10.00 10.0	
P01.16	Acceleration time 3	P01.45 = 0: 0.00–600.0 sec. P01.45 = 1: 0.0–6000 sec.	♦R/W	0110	40273	10.00 10.0	
P01.17	Deceleration time 3	P01.45 = 0: 0.00–600.0 sec. P01.45 = 1: 0.0–6000 sec.	♦R/W	0111	40274	10.00 10.0	
P01.18	Acceleration time 4	P01.45 = 0: 0.00–600.0 sec. P01.45 = 1: 0.0–6000 sec.	♦R/W	0112	40275	10.00 10.0	
P01.19	Deceleration time 4	P01.45 = 0: 0.00–600.0 sec. P01.45 = 1: 0.0–6000 sec.	♦R/W	0113	40276	10.00 10.0	
P01.20	JOG acceleration time	P01.45 = 0: 0.00–600.0 sec. P01.45 = 1: 0.0–6000 sec.	♦R/W	0114	40277	10.00 10.0	
P01.21	JOG deceleration time	P01.45 = 0: 0.00–600.0 sec. P01.45 = 1: 0.0–6000 sec.	♦R/W	0115	40278	10.00 10.0	
P01.22	JOG frequency	0.00–599.0 Hz	♦R/W	0116	40279	6.00	
P01.23	TRANS ACC/DEC1-4 Switch frequency between first and fourth Accel./Decel.	0.00–599.0 Hz	♦R/W	0117	40280	0.00	
P01.24	S-curve for acceleration begin time 1	P01.45 = 0: 0.00–25.00 sec. P01.45 = 1: 0.0–250.0 sec.	♦R/W	0118	40281	0.20 0.2	
(table continued next page)							

GS10 Parameters Summary – Basic Parameters (P01.xx) – (continued)							
Parameter		Range	Run* Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P01.25	S-curve for acceleration arrival time 2	P01.45 = 0: 0.00–25.00 sec. P01.45 = 1: 0.0–250.0 sec.	♦R/W	0119	40282	0.20 0.2	
P01.26	S-curve for deceleration begin time 1	P01.45 = 0: 0.00–25.00 sec. P01.45 = 1: 0.0–250.0 sec.	♦R/W	011A	40283	0.20 0.2	
P01.27	S-curve for deceleration arrival time 2	P01.45 = 0: 0.00–25.00 sec. P01.45 = 1: 0.0–250.0 sec.	♦R/W	011B	40284	0.20 0.2	
P01.28	Skip frequency 1 (upper limit)	0.00–599.0 Hz	R/W	011C	40285	0.00	
P01.29	Skip frequency 1 (lower limit)	0.00–599.0 Hz	R/W	011D	40286	0.00	
P01.30	Skip frequency 2 (upper limit)	0.00–599.0 Hz	R/W	011E	40287	0.00	
P01.31	Skip frequency 2 (lower limit)	0.00–599.0 Hz	R/W	011F	40288	0.00	
P01.32	Skip frequency 3 (upper limit)	0.00–599.0 Hz	R/W	0120	40289	0.00	
P01.33	Skip frequency 3 (lower limit)	0.00–599.0 Hz	R/W	0121	40290	0.00	
P01.34	Zero-speed mode	0: Output waiting 1: Zero-speed operation 2: Fmin (refer to P01.07 and P01.41)	R/W	0122	40291	0	
P01.35	Motor 2, Output frequency (Base frequency / Motor's rated frequency)	0.00–599.0 Hz	R/W	0123	40292	60.00 / 50.00	
P01.36	Motor 2, Output voltage (Base voltage / Motor's rated voltage)	120V / 230V models: 0.0–255.0 V 460V models: 0.0–510.0 V	R/W	0124	40293	220.0 440.0	
P01.37	Motor 2, Mid-point frequency	0.00–599.0 Hz	R/W	0125	40294	3.0	
P01.38	Motor 2, Mid-point voltage 1	120V / 230V models: 0.0–240.0 V 460V models: 0.0–480.0 V	♦R/W	0126	40295	11.0 22.0	
P01.39	Motor 2, Mid-point frequency 2	0.00–599.0 Hz	R/W	0127	40296	1.50	
P01.40	Motor 2, Mid-point voltage 2	120V / 230V models: 0.0–240.0 V 460V models:0.0–480.0 V	♦R/W	0128	40297	5.0 10.0	
P01.41	Motor 2, Minimum output frequency	0.00–599.0 Hz	R/W	0129	40298	0.50	
P01.42	Motor 2, Minimum output voltage	120V / 230V models: 0.0–240.0 V 460V models: 0.0–480.0 V	♦R/W	012A	40299	1.0 2.0	
P01.43	V/F curve selection	0: V/F curve determined by P01.00–P01.08 1: V/F curve to the power of 1.5 2: V/F curve to the power of 2	R/W	012B	40300	0	
P01.44	Auto-acceleration and auto-deceleration setting	0: Linear acceleration and deceleration 1: Auto-acceleration and linear deceleration 2: Linear acceleration and auto-deceleration 3: Auto-acceleration and auto-deceleration 4: Stall prevention by auto-acceleration and auto-deceleration (limited by P01.12 –P01.21)	♦R/W	012C	40301	0	

(table continued next page)

GS10 Parameters Summary – Basic Parameters (P01.xx) – (continued)							
Parameter		***Range***	***Run* Read/ Write***	***Modbus Address***		***Settings***	
				Hex	***Dec***	***Default***	***User***
P01.45	Time unit for acceleration / deceleration and S-curve	0: Unit 0.01 sec. 1: Unit 0.1 sec.	R/W	012D	40302	0	
P01.49	Regenerative energy restriction control (decel method)	0: Disable 1: Over voltage energy restriction 2: Traction energy control (TEC)	R/W	0131	40306	0	
P01.52	Motor 2, Maximum operation frequency	0.00–599.0 Hz	R/W	0134	40309	60.00 / 50.00	

Digital Input/Output Parameters Summary (P02.xx)

For detailed information about the P02.xx parameter group, please refer to *page 4–75*.

GS10 Parameters Summary – Digital Input/Output Parameters (P02.xx)							
Parameter		***Range***	***Run[1] Read/ Write***	***Modbus Address***		***Settings***	
				Hex	***Dec***	***Default[2]***	***User***
1) ♦ in the Run-Read/Write column indicates that the parameter can be set during RUN mode. R/W indicates "Read/Write." Read indicates "Read-only." *2) Parameters can be restored to their default values using P00.02.*							
P02.00	Two-wire / three-wire operation control	Note: On the drive, DI1 is labeled FWD, and DI2 is labeled REV. 0: No function 1: Two-wire mode 1, power on for operation control (DI1: FWD/STOP, DI2: REV/STOP) 2: Two-wire mode 2, power on for operation control (DI1: RUN/STOP, DI2: REV/FWD) 3: Three-wire, power on for operation control (DI1: RUN, DI2: REV/FWD, DI3: STOP) 4: Two-wire mode 1, Quick Start (DI1: FWD/STOP, DI2: REV/STOP) 5: Two-wire mode 2, Quick Start (DI1: RUN/STOP, DI2: REV/FWD) 6: Three-wire, Quick Start (DI1: RUN, DI2: REV/FWD, DI3: STOP) **IMPORTANT** 1) In the QuickStart function, terminal output remains in ready status, and the drive responds to the start command immediately. 2) When using the Quick Start function, output terminals U, V, and W are powered immediately. To avoid electric shock hazard, do not touch the terminals or modify the motor wiring.	R/W	0200	40513	1	
(table continued next page)							

GS10 Parameters Summary – Digital Input/Output Parameters (P02.xx) – (continued)							
Parameter		Range	Run Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P02.01	Multi-function input command 1 (FWD/DI1)	0: No function 1: Multi-step speed command 1 2: Multi-step speed command 2 3: Multi-step speed command 3 4: Multi-step speed command 4 5: Reset 6: JOG [by external control or GS4-KPD (optional)] 7: Acceleration / deceleration speed inhibit 8: 1st and 2nd acceleration / deceleration time selection 9: 3rd and 4th acceleration / deceleration time selection 10: External Fault (EF) Input (P07.20) 11: Base Block (B.B.) input from external source 12: Output stop 13: Cancel the setting of auto-acceleration / auto-deceleration time 15: Rotating speed command from AI 18: Force to stop (P07.20) 19: Digital up command 20: Digital down command 21: PID function disabled 22: Clear the counter 23: Input the counter value (DI4) 24: FWD JOG command 25: REV JOG command 28: Emergency stop (EF1) 29: Signal confirmation for Y-connection 30: Signal confirmation for Δ-connection 38: Disable writing EEPROM function 40: Force coasting to stop 41: HAND switch 42: AUTO switch 49: Enable drive 50: Slave dEb action to execute 56: Local / Remote selection 58: Enable fire mode (with RUN command) 59: Enable fire mode (without RUN command) 69: Auto-activate preheating command 70: Force auxiliary frequency return to 0 71: Disable PID function, force PID output return to 0	R/W	0201	40514	0	
(table continued next page)							

GS10 Parameters Summary – Digital Input/Output Parameters (P02.xx) – (continued)							
Parameter		Range	Run Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P02.01 (cont'd)	Multi-function input command 1 (FWD/DI1) (continued)	72: Disable PID function, retain the output value before disabled 73: Force PID integral gain return to 0, disable integral 74: Reverse PID feedback 83: Multi-motor (IM) selection bit 0 94: Programmable AUTO RUN 95: Pausing AUTO RUN 97: Multi-pump switch by HAND/ AUTO mode 98: Simple positioning stop by forward limit 99: Simple positioning stop by reverse limit	R/W	0201	40514	0	
P02.02	Multi-function input command 2 (REV/DI2)	See P02.01 for values.	R/W	0202	40515	0	
P02.03	Multi-function input command 3 (DI3)	See P02.01 for values.	R/W	0203	40516	1	
P02.04	Multi-function input command 4 (DI4)	See P02.01 for values.	R/W	0204	40517	2	
P02.05	Multi-function input command 5 (DI5)	See P02.01 for values.	R/W	0205	40518	3	
P02.09	UP / DOWN key mode	0: UP / DOWN by the acceleration / deceleration time 1: UP / DOWN constant speed (P02.10) 2: Pulse signal (P02.10) 3: Curve	♦R/W	0209	40522	0	
P02.10	Constant speed, acceleration / deceleration speed of the UP/DOWN Key	0.001–1.000 Hz/ms	♦R/W	020A	40523	0.001	
P02.11	Multi-function input response time	0.000–30.000 sec.	♦R/W	020B	40524	0.005	
P02.12	Multi-function input mode selection	0000h–FFFFh (0: N.O.; 1: N.C.)	♦R/W	020C	40525	0000	

(table continued next page)

GS10 Parameters Summary – Digital Input/Output Parameters (P02.xx) – (continued)							
Parameter		**Range**	**Run Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P02.13	Multi-function output 1 (R1)	0: No function 1: Indication during RUN 2: Operation speed reached 3: Desired frequency reached 1 (P02.22) 4: Desired frequency reached 2 (P02.24) 5: Zero speed (Frequency command) 6: Zero speed including STOP (Frequency command) 7: Over-torque 1 (P06.06–06.08) 8: Over-torque 2 (P06.09–06.11) 9: Drive is ready 10: Low voltage warning (Lv) (P06.00) 11: Malfunction indication 13: Overheat warning (P06.15) 14: Software brake signal indicator (P07.00) 15: PID feedback error (P08.13, P08.14) 16: Slip error (oSL) 17: Count value reached, does not return to 0 (P02.20) 18: Count value reached, return to 0 (P02.19) 19: External interrupt B.B. input (Base Block) 20: Warning output 21: Over-voltage 22: Over-current stall prevention 23: Over-voltage stall prevention 24: Operation mode 25: Forward command 26: Reverse command 29: Output when frequency ≥ P02.34 30: Output when frequency < P02.34 31: Y-connection for the motor coil 32: Δ-connection for the motor coil 33: Zero speed (actual output frequency) 34: Zero speed including STOP (actual output frequency) 35: Error output selection 1 (P06.23) 36: Error output selection 2 (P06.24) 37: Error output selection 3 (P06.25) 38: Error output selection 4 (P06.26) 40: Speed reached (including STOP) 42: Crane function 43: Motor speed detection 44: Low current output (use with P06.71–06.73) 45: UVW output electromagnetic valve switch 46: Master dEb output	♦R/W	020D	40526	11	
(table continued next page)							

GS10 Parameters Summary – Digital Input/Output Parameters (P02.xx) – (continued)							
Parameter		**Range**	**Run Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P02.13 (cont'd)	Multi-function output 1 (R1) (continued)	51: Analog output control for RS-485 interface 53: Fire mode indication 67: Analog input level reached 69: Preheating output indication 75: Forward RUN status 76: Reverse RUN status 77: Program Running indication 78: Program Step Completed indication 79: Program Running Completed indication 80: Program Running paused indication 81: Multi-pump system error display (only master)	♦R/W	020D	40526	11	
P02.16	Multi-function output 2 (DO1)	See P02.13 for values.	♦R/W	0210	40529	0	
P02.18	Multi-function output direction ACT	0000h–FFFFh (0: N.O.; 1: N.C.)	♦R/W	0212	40531	0000h	
P02.19	Terminal counting value reached (returns to 0)	0–65500	♦R/W	0213	40532	0	
P02.20	Preliminary (Middle) counting value reached (does not return to 0)	0–65500	♦R/W	0214	40533	0	
P02.22	Desired frequency reached 1	0.00–599.0 Hz	♦R/W	0216	40535	60.00 / 50.00	
P02.23	The bandwidth of the desired frequency reached 1	0.00–599.0 Hz	♦R/W	0217	40536	2.00	
P02.24	Desired frequency reached 2	0.00–599.0 Hz	♦R/W	0218	40537	60.00 / 50.00	
P02.25	The bandwidth of the desired frequency reached 2	0.00–599.0 Hz	♦R/W	0219	40538	2.00	
P02.34	Output frequency setting for digital output terminal	0.00–599.0 Hz (Motor speed when using PG Card)	♦R/W	0222	40547	0.00	
P02.35	External operation control selection after fault reset and reboot	0: Disable 1: Drive runs if the RUN command remains after reset or reboot	♦R/W	0223	40548	0	
P02.47	Motor RPM zero-speed level	0–65535 rpm	♦R/W	022F	40560	0	
P02.50	Display the status of multi-function input terminals DI1-DI5	Monitor the status of multi-function input terminals	Read	0232	40563	0	
P02.51	Display the status of multi-function output terminals R1, DO1	Monitor the status of digital output terminals	Read	0233	40564	0	
P02.54	Display the frequency command executed by external terminal (EXT Speed REC)	0.00–599.0 Hz (Read only)	Read	0236	40567	0	

(table continued next page)

GS10 Parameters Summary – Digital Input/Output Parameters (P02.xx) – (continued)							
Parameter		Range	Run Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P02.58	Multi-function output terminal (function 42): brake frequency check point	0.00–599.0 Hz	♦R/W	023A	40571	0.00	
P02.72	Preheating output current level	0–100%	♦R/W	0248	40585	0	
P02.73	Preheating output cycle	0–100%	♦R/W	0249	40586	0	
P02.81	EF activates when the terminal count value reached	0: Terminal count value reached, no EF displays (continues to operate) 1: Terminal count value reached, EF activates	♦R/W	0251	40594	0	
P02.82	Initial Frequency com-mand (F) mode after stop	0: Use current Frequency command 1: Use zero Frequency Command 2: Refer to P02.83 to set up	♦R/W	0252	40595	0	
P02.83	Initial Frequency com-mand (F) setting after stop	0.00–599.0 Hz	♦R/W	0253	40596	60.00	

Analog Input/Output Parameters Summary (P03.xx)

For detailed information about the P03.xx parameter group, please refer to page 4–97.

GS10 Parameters Summary – Analog Input/Output Parameters (P03.xx)							
Parameter		***Range***	***Run[1] Read/ Write***	***Modbus Address***		***Settings***	
				Hex	***Dec***	***Default[2]***	***User***
1) ♦ in the Run-Read/Write column indicates that the parameter can be set during RUN mode. R/W indicates "Read/Write." Read indicates "Read-only." 2) Parameters can be restored to their default values using P00.02.							
P03.00	Analog input selection (AI)	0: No function 1: Frequency command 4: PID target value 5: PID feedback signal 6: Thermistor (PTC) input value 11: PT100 RTD input value 12: Auxiliary frequency input 13: PID compensation value	♦R/W	0300	40769	1	
P03.03	Analog input bias (AI-V)	-100.0–100.0%	♦R/W	0302	40771	0	
P03.04	Analog input bias (AI-C)	-100.0–100.0%	♦R/W	0303	40772	0	
P03.07	Positive / negative bias mode (AI-V))	0: No bias 1: Lower than or equal to bias 2: Greater than or equal to bias 3: The absolute value of the bias voltage while serving as the center 4: Bias serves as the center	♦R/W	0304	40773	0	
P03.08	Positive / negative bias mode (AI-C))		♦R/W	0308	40777	0	
P03.10	Reverse setting when analog signal input is negative frequency	0: Negative frequency input is not allowed. The digital keypad or external terminal controls the forward and reverse direction. 1: Negative frequency input is allowed. Positive frequency = run in a forward direction; negative frequency = run in a reverse direction. The digital keypad or external terminal control cannot change the running direction.	♦R/W	030A	40779	0	
P03.11	Analog input gain (AI-V)	-500.0–500.0%	♦R/W	030B	40780	100.0	
P03.12	Analog input gain (AI-C)	-500.0–500.0%	♦R/W	030C	40781	100.0	
P03.15	Analog input filter (LPF) time (AI-V)	0.00–20.00 sec.	♦R/W	030F	40784	0.01	
P03.16	Analog input filter (LPF) time (AI-C)	0.00–20.00 sec.	♦R/W	0310	40785	0.01	
P03.19	Signal loss selection for AI-C analog input 4–20 mA	0: Disable 1: Continue operation at the last frequency 2: Decelerate to 0 Hz 3: Stop immediately and display "ACE"	R/W	0313	40788	0	

(table continued next page)

GS10 Parameters Summary – Analog Input/Output Parameters (P03.xx) – (continued)							
Parameter		Range	Run* Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P03.20	Multi-function output (AO1)	0: Output frequency (Hz) 1: Frequency command (Hz) 2: Motor speed (Hz) 3: Output current (rms) 4: Output voltage 5: DC bus voltage 6: Power factor 7: Power 8: TQR Output 9: Analog Input (AI-V or AI-C) 12: Iq current command 13: Iq feedback value 14: Id current command 15: Id feedback value 16: Vq-axis voltage command 17: Vd-axis voltage command 21: RS-485 analog output 23: Constant voltage output	♦R/W	0314	40789	0	
P03.21	Analog output gain (AO1)	0.0–500.0%	♦R/W	0315	40790	100.0	
P03.22	Analog output in REV direction (AO1)	0: Absolute value in output voltage 1: Reverse output 0 V; forward output 0–10 V 2: Reverse output 5–0 V; forward output 5–10 V	♦R/W	0316	40791	0	
P03.27	AO1 output bias	-100.00–100.00%	♦R/W	031B	40796	0.00	
P03.28	AI terminal input selection	0: 0–10 V (only P03.63–P03.68 are valid) 1: 0–20 mA (P03.57–P03.62 are valid) 2: 4–20 mA (P03.57–P03.62 are valid)	♦R/W	031C	40797	0	
P03.32	AO1 DC output setting level	0.00–100.00%	♦R/W	0320	40801	0.00	
P03.35	AO1 output filter time	0.00–20.00 sec.	♦R/W	0323	40804	0.01	
P03.39	VR (keypad dial) input selection	0: Disable 1: Frequency command	♦R/W	0327	40808	1	
P03.40	VR (keypad dial) input bias	-100.0–100.0%	♦R/W	0328	40809	0.0	
P03.41	VR (keypad dial) positive / negative bias	0: No bias 1: Lower than or equal to bias 2: Greater than or equal to bias 3: The absolute value of the bias voltage while serving as the center 4: Bias serves as the center	♦R/W	0329	40810	0	
P03.42	VR (keypad dial) gain	-500.0–500.0%	♦R/W	032A	40811	100.0	
P03.43	VR (keypad dial) filter time	0.00–2.00 sec.	♦R/W	032B	40812	0.01	
P03.44	Multi-function output (DO) by AI level source	0: AI-V 1: AI-C	♦R/W	032C	40813	0	
P03.45	AI upper level	-100–100%	♦R/W	032D	40814	50	
P03.46	AI lower level	-100–100%	♦R/W	032E	40815	10	
P03.47	AI-V %	-100–100%	Read	032F	40816	0	
P03.48	AI-C %	-100–100%	Read	0330	40817	0	
P03.50	Analog input curve calculation selection	0: Normal curve 1: Three-point curve of AI-V 2: Three-point curve of AI-C	♦R/W	0332	40819	0	
P03.57	AI-C lowest point	P03.28 = 1, 0.00–10.00 V P03.28 ≠ 1, 0.00–20.00 mA	♦R/W	0339	40826	4.00	
P03.58	AI-C proportional lowest point	0.00–100.00%	♦R/W	033A	40827	0.00	
(table continued next page)							

GS10 Parameters Summary – Analog Input/Output Parameters (P03.xx) – (continued)							
Parameter		Range	Run* Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P03.59	AI-C mid-point	P03.29 = 1, 0.00–10.00 V P03.29 ≠ 1, 0.00–20.00 mA	♦R/W	033B	40828	12.00	
P03.60	AI-C proportional mid-point	0.00–100.00%	♦R/W	033C	40829	50.00	
P03.61	AI-C highest point	P03.28 = 1, 0.00–10.00 V P03.28 ≠ 1, 0.00–20.00 mA	♦R/W	033D	40830	20.00	
P03.62	AI-C proportional highest point	0.00–100.00%	♦R/W	033E	40831	100.00	
P03.63	AI-V voltage lowest point	0.00–10.00 V	♦R/W	033F	40832	0.00	
P03.64	AI-V proportional lowest point	-100.00–100.00%	♦R/W	0340	40833	0.00	
P03.65	AI-V voltage mid-point	0.00–10.00 V	♦R/W	0341	40834	5.00	
P03.66	AI-V proportional mid-point	-100.00–100.00%	♦R/W	0342	40835	50.00	
P03.67	AI-V voltage highest point	0.00–10.00 V	♦R/W	0343	40836	10.00	
P03.68	AI-V proportional highest point	-100.00–100.00%	♦R/W	0344	40837	100.00	

Multi-Step Speed Parameters Summary (P04.xx)

For detailed information about the P04.xx parameter group, please refer to *page 4–127*.

GS10 Parameters Summary – Multi-Step Speed Parameters (P04.xx)							
Parameter		***Range***	***Run[1)]Read/ Write***	***Modbus Address***		***Settings***	
				Hex	***Dec***	***Default[2)]***	***User***
1) ♦ in the Run-Read/Write column indicates that the parameter can be set during RUN mode. R/W indicates "Read/Write." Read indicates "Read-only." 2) Parameters can be restored to their default values using P00.02.							
P04.00	1st step speed frequency	0.00–599.0 Hz	♦R/W	0400	41025	0.00	
P04.01	2nd step speed frequency	0.00–599.0 Hz	♦R/W	0401	41026	0.00	
P04.02	3rd step speed frequency	0.00–599.0 Hz	♦R/W	0402	41027	0.00	
P04.03	4th step speed frequency	0.00–599.0 Hz	♦R/W	0403	41028	0.00	
P04.04	5th step speed frequency	0.00–599.0 Hz	♦R/W	0404	41029	0.00	
P04.05	6th step speed frequency	0.00–599.0 Hz	♦R/W	0405	41030	0.00	
P04.06	7th step speed frequency	0.00–599.0 Hz	♦R/W	0406	41031	0.00	
P04.07	8th step speed frequency	0.00–599.0 Hz	♦R/W	0407	41032	0.00	
P04.08	9th step speed frequency	0.00–599.0 Hz	♦R/W	0408	41033	0.00	
P04.09	10th step speed frequency	0.00–599.0 Hz	♦R/W	0409	41034	0.00	
P04.10	11th step speed frequency	0.00–599.0 Hz	♦R/W	040A	41035	0.00	
P04.11	12th step speed frequency	0.00–599.0 Hz	♦R/W	040B	41036	0.00	
P04.12	13th step speed frequency	0.00–599.0 Hz	♦R/W	040C	41037	0.00	
P04.13	14th step speed frequency	0.00–599.0 Hz	♦R/W	040D	41038	0.00	
P04.14	15th step speed frequency	0.00–599.0 Hz	♦R/W	040E	41039	0.00	

Motor Parameters Summary (P05.xx)

For detailed information about the P05.xx parameter group, please refer to *page 4–129*.

GS10 Parameters Summary – Motor Parameters (P05.xx)							
Parameter		**Range**	**Run[1] Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default[2]**	**User**
1) ♦ in the Run-Read/Write column indicates that the parameter can be set during RUN mode. R/W indicates "Read/Write." Read indicates "Read-only." 2) Parameters can be restored to their default values using P00.02.							
P05.00	Motor parameter auto-tuning	0: No function 1: Dynamic test for induction motor (IM) 2: Static test for induction motor (IM) 5: Rotary Test for PM 13: Static Auto-tuning for PM	R/W	0500	41281	0	
P05.01	Induction Motor 1, Full-load amps	10–120% of the drive's rated current	R/W	0501	41282	Model dependent	
P05.02	Induction Motor 1, Rated power (kW)	0.00–655.35 kW	♦R/W	0502	41283	Model dependent	
P05.03	Induction Motor 1, Rated speed (rpm)	0–xxxxx rpm (Depending on the motor's number of poles) 1710 (60Hz, 4 poles); 1410 (50Hz, 4 poles)	♦R/W	0503	41284	1710	
P05.04	Induction Motor 1, Number of poles	2–20	R/W	0504	41285	4	
P05.05	Induction Motor 1, No-load amps	0.00–P05.01 default	R/W	0505	41286	Model dependent	
P05.06	Induction Motor 1, Stator resistance (Rs)	0.000–65.535 Ω	R/W	0506	41287	Model dependent	
P05.07	Induction Motor 1, Rotor resistance (Rr)	0.000–65.535 Ω	R/W	0507	41288	0.000	
P05.08	Induction Motor 1, Magnetizing inductance (Lm)	0.0–6553.5 mH	R/W	0508	41289	0.0	
P05.09	Induction Motor 1, Stator inductance (Lx)	0.0–6553.5 mH	R/W	0509	41290	0.0	
P05.13	Induction Motor 2, Full-load amps	10–120% of the drive's rated current	R/W	050D	41294	Model dependent	
P05.14	Induction Motor 2, Rated power (kW)	0.00–655.35 kW	♦R/W	050E	41295	Model dependent	
P05.15	Induction Motor 2, Rated speed (rpm)	0–xxxxx rpm (Depending on the motor's number of poles) 1710 (60Hz, 4 poles); 1410 (50Hz, 4 poles)	♦R/W	050F	41296	1710	
P05.16	Induction Motor 2, Number of poles	2–20	R/W	0510	41297	4	
P05.17	Induction Motor 2, No-load amps	0.00–P05.13 default	R/W	0511	41298	Model dependent	
P05.18	Induction Motor 2, Stator resistance (Rs)	0.000–65.535 Ω	R/W	0512	41299	Model dependent	
P05.19	Induction Motor 2, Rotor resistance (Rr)	0.000–65.535 Ω	R/W	0513	41300	0.000	
P05.20	Induction Motor 2, Magnetizing inductance (Lm)	0.0–6553.5 mH	R/W	0514	41301	0.0	
P05.21	Induction Motor 2, Stator inductance (Lx)	0.0–6553.5 mH	R/W	0515	41302	0.0	
P05.22	Multi-motor (induction) selection	1: Motor 1 2: Motor 2	R/W	0516	41303	1	
(table continued next page)							

GS10 Parameters Summary – Motor Parameters (P05.xx) – (continued)							
Parameter		Range	Run* Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P05.23	Frequency for Y-connection / Δ-connection switch for an induction motor	0.00–599.0 Hz	♦R/W	0517	41304	60.00	
P05.24	Y-connection /Δ-connection switch for an induction motor	0: Disable 1: Enable	R/W	0518	41305	0	
P05.25	Delay time for Y-connection /Δ-connection switch for an induction motor	0.000–60.000 sec.	♦R/W	0519	41306	0.200	
P05.26	Accumulated Watt-second for a motor in low word (W-msec.)	Read only	Read	051A	41307	0	
P05.27	Accumulated Watt-second for a motor in high word (W-sec.)	Read only	Read	051B	41308	0	
P05.28	Accumulated Watt-hour for a motor (W-hour)	Read only	Read	051C	41309	0	
P05.29	Accumulated Watt-hour for a motor in low word (kW-hour)	Read only	Read	051D	41310	0	
P05.30	Accumulated Watt-hour for a motor in high word (MW-hour)	Read only	Read	051E	41311	0	
P05.31	Accumulated motor operation time (Minutes)	0–1439	R/W	051F	41312	0	
P05.32	Accumulated motor operation time (days)	0–65535	R/W	0520	41313	0	
P05.33	Induction motor (IM) or permanent magnet synchronous AC motor (PM) selection	0: IM (Induction motor) 1: SPM (Surface permanent magnet synchronous AC motor) 2: IPM (Interior permanent magnet synchronous AC motor)	R/W	0521	41314	0	
P05.34	Full-load current for a permanent magnet synchronous AC motor	0–120% of the drive's rated current	R/W	0522	41315	Model dependent	
P05.35	Rated power for a permanent magnet synchronous AC motor	0.00–655.35 kW	R/W	0523	41316	Model dependent	
P05.36	Rated speed for a permanent magnet synchronous AC motor	0–65535 rpm	R/W	0524	41317	2000	
P05.37	Number of poles for a permanent magnet synchronous AC motor	0–65535	R/W	0525	41318	10	
P05.39	Stator resistance Rs for a permanent magnet synchronous AC motor	0.000–65.535 Ω	R/W	0527	41320	0.000	
P05.40	Permanent magnet synchronous AC motor Ld	0.00–655.35 mH	R/W	0528	41321	0.00	
P05.41	Permanent magnet synchronous AC motor Lq	0.00–655.35 mH	R/W	0529	41322	0.00	
(table continued next page)							

GS10 Parameters Summary – Motor Parameters (P05.xx) – (continued)							
Parameter		**Range**	**Run* Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P05.43	Ke parameter of a permanent magnet synchronous AC motor	0–65535 (Unit: V / krpm)	R/W	052B	41324	0	

Protection Parameters Summary (P06.xx)

For detailed information about the P06.xx parameter group, please refer to page 4–136.

GS10 Parameters Summary – Protection Parameters (P06.xx)							
Parameter		**Range**	**Run[1] Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default[2]**	**User**
1) ♦ in the Run-Read/Write column indicates that the parameter can be set during RUN mode. R/W indicates "Read/Write." Read indicates "Read-only." 2) Parameters can be restored to their default values using P00.02.							
P06.00	Low voltage level	120V / 230V models: 150.0–220.0 VDC 460V models: 300.0–440.0 VDC	♦R/W	0600	41537	180.0 360.0	
P06.01	Over-voltage stall prevention	0: Disable 120V / 230V models: 0.0–390.0 VDC 460V models: 0.0–900.0 VDC	♦R/W	0601	41538	380.0 760.0	
P06.02	Selection for over-voltage stall prevention	0: Traditional over-voltage stall prevention 1: Smart over-voltage stall prevention	♦R/W	0602	41539	0	
P06.03	Over-current stall prevention during acceleration (OCA)	VT: 0–150% (100% corresponds to the rated current of the drive) CT: 0–200% (100% corresponds to the rated current of the drive)	♦R/W	0603	41540	120 180	
P06.04	Over-current stall prevention during operation (OCN)	VT: 0–150% (100% corresponds to the rated current of the drive) CT: 0–200% (100% corresponds to the rated current of the drive)	♦R/W	0604	41541	120 180	
P06.05	Acceleration / deceleration time selection for stall prevention at constant speed	0: By current acceleration / deceleration time 1: By the first acceleration / deceleration time 2: By the second acceleration / deceleration time 3: By the third acceleration / deceleration time 4: By the fourth acceleration / deceleration time 5: By Auto-acceleration / auto-deceleration	♦R/W	0605	41542	0	
P06.06	Over-torque detection selection (motor 1)	0: No function 1: Continue operation after over-torque detection during constant speed operation 2: Stop after over-torque detection during constant speed operation 3: Continue operation after over-torque detection during RUN 4: Stop after over-torque detection during RUN	♦R/W	0606	41543	0	
P06.07	Over-torque detection level (motor 1)	10–250% (100% corresponds to the rated current of the drive)	♦R/W	0607	41544	120	
P06.08	Over-torque detection time (motor 1)	0.1–60.0 sec.	♦R/W	0608	41545	0.1	

(table continued next page)

GS10 Parameters Summary – Protection Parameters (P06.xx) – (continued)							
Parameter		***Range***	***Run* Read/ Write***	***Modbus Address***		***Settings***	
				Hex	***Dec***	***Default***	***User***
P06.09	Over-torque detection selection (motor 2)	0: No function 1: Continue operation after over-torque detection during constant speed operation 2: Stop after over-torque detection during constant speed operation 3: Continue operation after over-torque detection during RUN 4: Stop after over-torque detection during RUN	♦R/W	0609	41546	0	
P06.10	Over-torque detection level (motor 2)	10–250% (100% corresponds to the rated current of the drive)	♦R/W	060A	41547	120	
P06.11	Over-torque detection time (motor 2)	0.1–60.0 sec.	♦R/W	060B	41548	0.1	
P06.13	Electronic thermal relay selection 1 (motor 1)	0: Inverter motor (with external forced cooling) 1: Standard motor (motor with fan on the shaft) 2: Disabled	♦R/W	060D	41550	2	
P06.14	Electronic thermal relay action time 1 (motor 1)	30.0–600.0 sec.	♦R/W	060E	41551	60.0	
P06.15	Temperature level overheat (OH) warning	0.0–110.0°C	♦R/W	060F	41552	Model dependent	
P06.16	Stall prevention limit level (Weak magnetic field current stall prevention level)	0–100% (refer to P06.03–P06.04)	♦R/W	0610	41553	100	
(table continued next page)							

GS10 Parameters Summary – Protection Parameters (P06.xx) – (continued)							
Parameter		**Range**	**Run* Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P06.17	Fault record 1	0: No fault record 1: Over-current during acceleration (ocA) 2: Over-current during deceleration (ocd) 3: Over-current during steady operation (ocn) 4: Ground fault (GFF) 6: Over-current at stop (ocS) 7: Over-voltage during acceleration (ovA) 8: Over-voltage during deceleration (ovd) 9: Over-voltage during constant speed (ovn) 10: Over-voltage at stop (ovS) 11: Low-voltage during acceleration (LvA) 12: Low-voltage during deceleration (Lvd) 13: Low-voltage during constant speed (Lvn) 14: Low-voltage at stop (LvS) 15: Phase loss protection (orP) 16: IGBT overheating (oH1) 18: IGBT temperature detection failure (tH1o) 21: Over load (oL) 22: Electronic thermal relay 1 protection (EoL1) 23: Electronic thermal relay 2 protection (EoL2) 24: Motor PTC overheating (oH3) 26: Over torque 1 (ot1) 27: Over torque 2 (ot2) 28: Under current (uC) 31: EEPROM read error (cF2) 33: U-phase error (cd1) 34: V-phase error (cd2) 35: W-phase error (cd3) 36: cc (current clamp) hardware error (Hd0) 37: oc (over-current) hardware error (Hd1) 40: Auto-tuning error (AUE) 41: PID loss AI-V (AFE) 48: AI-C loss (ACE) 49: External fault (EF) 50: Emergency stop (EF1) 51: External Base Block (bb) 52: Password is locked (Pcod) 54: Illegal command (CE1) 55: Illegal data address (CE2) 56: Illegal data value (CE3) 57: Data is written to read-only address (CE4) 58: Modbus transmission time-out (CE10)	Read	0611	41554	0	

(table continued next page)

GS10 Parameters Summary – Protection Parameters (P06.xx) – (continued)							
Parameter		Range	Run* Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P06.17 (cont'd)	Fault record 1 (continued)	63: Over slip error (oSL) 82: Output phase loss U phase (oPL1) 83: Output phase loss V phase (oPL2) 84: Output phase loss W phase (oPL3) 87: Low frequency overload protection (oL3) 142: Auto-tune error 1 (DC test stage) (AuE1) 143: Auto-tune error 2 (High frequency test stage) (AuE2) 149: Total resistance measurement fault (AUE5) 150: No-load current IO measurement fault (AUE6) 151: dq axis inductance measurement fault (AUE7) 152: High frequency injection measurement fault (AUE8) 157: Pump PID feedback error (dEv)	Read	0611	41554	0	
P06.18	Fault record 2	See P06.17 for ranges.	Read	0612	41555	0	
P06.19	Fault record 3	See P06.17 for ranges.	Read	0613	41556	0	
P06.20	Fault record 4	See P06.17 for ranges.	Read	0614	41557	0	
P06.21	Fault record 5	See P06.17 for ranges.	Read	0615	41558	0	
P06.22	Fault record 6	See P06.17 for ranges.	Read	0616	41559	0	
P06.23	Fault output option 1	0–65535 (refer to bit table for fault code)	♦R/W	0617	41560	0	
P06.24	Fault output option 2	0–65535 (refer to bit table for fault code)	♦R/W	0618	41561	0	
P06.25	Fault output option 3	0–65535 (refer to bit table for fault code)	♦R/W	0619	41562	0	
P06.26	Fault output option 4	0–65535 (refer to bit table for fault code)	♦R/W	061A	41563	0	
P06.27	Electronic thermal relay selection 2 (motor 2)	0: Inverter motor (with external forced cooling) 1: Standard motor (motor with fan on the shaft) 2: Disabled	♦R/W	061B	41564	2	
P06.28	Electronic thermal relay action time 2 (motor 2)	30.0–600.0 sec.	♦R/W	061C	41565	60.0	
P06.29	PTC detection selection	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning	♦R/W	061D	41566	0	
P06.30	PTC level	0.0–100.0%	♦R/W	061E	41567	50.0	
P06.31	Frequency command at malfunction	0.00–599.0 Hz	Read	061F	41568	0	
P06.32	Output frequency at malfunction	0.00–599.0 Hz	Read	0620	41569	0	
P06.33	Output voltage at malfunction	0.0–6553.5 V	Read	0621	41570	0	
P06.34	DC bus voltage at malfunction	0.0–6553.5 V	Read	0622	41571	0	
P06.35	Output current at malfunction	0.00–655.35 Amp	Read	0623	41572	0	
P06.36	IGBT temperature at malfunction	-3276.7–3276.7°C	Read	0624	41573	0	

(table continued next page)

GS10 Parameters Summary – Protection Parameters (P06.xx) – (continued)							
Parameter		Range	Run* Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P06.38	Motor speed at malfunction	-32767–32767 rpm	Read	0626	41575	0	
P06.39	Torque command at malfunction	-32767–32767 %	Read	0627	41576	0	
P06.40	Status of the digital input terminal at malfunction	0000h–FFFFh	Read	0628	41577	0	
P06.41	Status of the digital output terminal at malfunction	0000h–FFFFh	Read	0629	41578	0	
P06.42	Drive status at malfunction	0000h–FFFFh	Read	062A	41579	0	
P06.43	IGBT Temperature	-3276.7–3276.7 °C	Read	062B	41580	–	
P06.45	Output phase loss detection action (OPHL)	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning	♦R/W	062D	41582	3	
P06.46	Detection time for output phase loss	0.000–65.535 sec.	♦R/W	062E	41583	0.500	
P06.47	Current detection level for output phase loss	0.00–100.00%	♦R/W	062F	41584	1.00	
P06.48	DC brake time for output phase loss	0.000–65.535 sec.	♦R/W	0630	41585	0.000	
P06.49	LvX auto-reset	0: Disable 1: Enable	R/W	0631	41586	0	
P06.53	Input phase loss detection action (OrP)	0: Fault and ramp to stop 1: Fault and coast to stop	♦R/W	0635	41590	0	
P06.55	Derating protection	0: Constant rated current and limit carrier frequency by load current and temperature 1: Constant carrier frequency and limit load current by setting carrier frequency 2: Constant rated current (same as setting 0), but close current limit	♦R/W	0637	41592	0	
P06.56	PT100 RTD voltage level 1	0.000–10.000 V	♦R/W	0638	41593	5.000	
P06.57	PT100 RTD voltage level 2	0.000–10.000 V	♦R/W	0639	41594	7.000	
P06.58	PT100 RTD level 1 frequency protection	0.00–599.0 Hz	♦R/W	063A	41595	0.00	
P06.59	PT100 RTD activation level 1 protection frequency delay time	0–6000 sec.	♦R/W	063B	41596	60	
P06.60	Software detection GFF current level	0.0–6553.5%	♦R/W	063C	41597	60.0	
P06.61	Software detection GFF filter time	0.00–655.35 sec.	♦R/W	063D	41598	0.10	
P06.63	Operation time of fault record 1 (Days)	0–65535 days	Read	063F	41600	0	
P06.64	Operation time of fault record 1 (Minutes)	0–1439 min.	Read	0640	41601	0	
P06.65	Operation time of fault record 2 (Days)	0–65535 days	Read	0641	41602	0	

(table continued next page)

GS10 Parameters Summary – Protection Parameters (P06.xx) – (continued)							
Parameter		**Range**	**Run* Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P06.66	Operation time of fault record 2 (Minutes)	0–1439 min.	Read	0642	41603	0	
P06.67	Operation time of fault record 3 (Days)	0–65535 days	Read	0643	41604	0	
P06.68	Operation time of fault record 3 (Minutes)	0–1439 min.	Read	0644	41605	0	
P06.69	Operation time of fault record 4 (Days)	0–65535 days	Read	0645	41606	0	
P06.70	Operation time of fault record 4 (Minutes)	0–1439 min.	Read	0646	41607	0	
P06.71	Low current setting level	0.0–100.0%	♦R/W	0647	41608	0.0	
P06.72	Low current detection time	0.00–360.00 sec.	♦R/W	0648	41609	0.00	
P06.73	Low current action	0: No function 1: Fault and coast to stop 2: Fault and ramp to stop by the second deceleration time 3: Warn and continue operation	♦R/W	0649	41610	0	
P06.80	Fire mode	0: Disable 1: Operates in a counterclockwise direction 2: Operates in a clockwise direction	R/W	0650	41617	0	
P06.81	Operating frequency in fire mode	0.00–599.0 Hz	♦R/W	0651	41618	60.00	
P06.88	Operation times in fire mode	0–65535 times	Read			0	
P06.90	Operation time of fault record 5 (days)	0–65535 days	Read	065A	41627	0	
P06.91	Operation time of fault record 5 (Minutes)	0–1439 min.	Read	065B	41628	0	
P06.92	Operation time of fault record 6 (days)	0–65535 days	Read	065C	41629	0	
P06.93	Operation time of fault record 6 (Minutes)	0–1439 min.	Read	065D	41630	0	

Special Parameters Summary (P07.xx)

For detailed information about the P07.xx parameter group, please refer to page 4–159.

GS10 Parameters Summary – Special Parameters (P07.xx)							
Parameter		**Range**	**Run[1] Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default[2]**	**User**
1) ♦ in the Run-Read/Write column indicates that the parameter can be set during RUN mode. R/W *indicates "*Read*/Write."* Read *indicates "*Read*-only."* *2) Parameters can be restored to their default values using P00.02.*							
P07.00	Software brake chopper threshold level	120V / 230V models: 350.0–450.0 VDC 460V models: 700.0–900.0 VDC	♦R/W	0000	41793	370.0 740.0	
P07.01	DC brake current level	0–100%	♦R/W	0701	41794	0	
P07.02	DC brake time at start-up	0.0–60.0 sec.	♦R/W	0702	41795	0.0	
P07.03	DC brake time at STOP	0.0–60.0 sec.	♦R/W	0703	41796	0.0	
P07.04	DC brake frequency at STOP	0.00–599.0 Hz	♦R/W	0704	41797	0.00	
P07.05	Voltage increasing gain	1–200%	♦R/W	0705	41798	100	
P07.06	Restart after momentary power loss	0: Stop operation 1: Speed tracking by the speed before the power loss 2: Speed tracking by the minimum output frequency	♦R/W	0706	41799	0	
P07.07	Allowed power loss duration	0.0–20.0 sec.	♦R/W	0707	41800	2.0	
P07.08	Base Block time	0.0–60.0 sec.	♦R/W	0708	41801	0.5	
P07.09	Current limit of speed tracking	20–200%	♦R/W	0709	41802	100	
P07.10	Restart after fault action	0: Stop operation 1: Speed tracking by current speed 2: Speed tracking by minimum output frequency	♦R/W	070A	41803	0	
P07.11	Number of times of restart after fault	0–10	♦R/W	070B	41804	0	
P07.12	Speed tracking during start-up (Flying Restart)	0: Disable 1: Speed tracking by the maximum output frequency 2: Speed tracking by the motor frequency at start-up 3: Speed tracking by the minimum output frequency	♦R/W	070C	41805	0	
P07.13	dEb function selection	0: Disable 1: dEb with auto-acceleration / auto-deceleration, the drive does not output the frequency after the power is restored. 2: dEb with auto-acceleration / auto-deceleration, the drive outputs the frequency after the power is restored. 3: dEb low-voltage control, then the drive's voltage increases to 350 VDC / 700 VDC and ramps to stop after low frequency 4: dEb high-voltage control of 350 VDC / 700 VDC, and the drive ramps to stop	♦R/W	070D	41806	0	
P07.15	Dwell time at acceleration	0.00–600.0 sec.	♦R/W	070F	41808	0.00	
(table continued next page)							

GS10 Parameters Summary – Special Parameters (P07.xx) – (continued)							
Parameter		**Range**	**Run* Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P07.16	Dwell frequency at acceleration	0.00–599.0 Hz	♦R/W	0710	41809	0.00	
P07.17	Dwell time at deceleration	0.00–600.0 sec.	♦R/W	0711	41810	0.00	
P07.18	Dwell frequency at deceleration	0.00–599.0 Hz	♦R/W	0712	41811	0.00	
P07.19	Fan cooling control	0: Fan is always ON 1: Fan is OFF after the AC motor drive stops for one minute. 2: Fan is ON when the AC motor drive runs, fan is OFF when the AC motor drive stops. 3: Fan turns ON when temperature (IGBT) reaches approx 60°C.	♦R/W	0713	41812	3	
P07.20	Emergency stop (EF) & force to stop selection	0: Coast to stop 1: Stop by the first deceleration time 2: Stop by the second deceleration time 3: Stop by the third deceleration time 4: Stop by the fourth deceleration time 5: System deceleration 6: Automatic deceleration	♦R/W	0714	41813	0	
P07.21	Automatic energy-saving setting	0: Disable 1: Enable	♦R/W	0715	41814	0	
P07.22	Energy-saving gain	10–1000%	♦R/W	0716	41815	100	
P07.23	Automatic voltage regulation (AVR) function	0: Enable AVR 1: Disable AVR 2: Disable AVR during deceleration	♦R/W	0717	41816	0	
P07.24	Torque command filter time (V/F and SVC control mode)	0.001–10.000 sec.	♦R/W	0718	41817	0.050	
P07.25	Slip compensation filter time (V/F and SVC control mode)	0.001–10.000 sec.	♦R/W	0719	41818	0.100	
P07.26	Torque compensation gain (V/F and SVC control mode)	IM: 0–10 (when P05.33 = 0) PM: 0–5000 (when P05.33 = 1 or 2)	♦R/W	071A	41819	1	
P07.27	Slip compensation gain (V/F and SVC control mode)	0.00–10.00	♦R/W	071B	41820	0.00 (Default value is 1.00 in SVC mode)	
P07.29	Slip deviation level	0.0–100.0% 0: No detection	♦R/W	071D	41822	0	
P07.30	Over-slip deviation detection time	0.0–10.0 sec.	♦R/W	071E	41823	1.0	
P07.31	Over-slip deviation treatment	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning	♦R/W	071F	41824	0	
P07.32	Motor oscillation compensation factor	0–10000	♦R/W	0720	41825	1000	
P07.33	Auto-restart interval of fault	0.0–6000 sec.	♦R/W	0721	41826	60.0	

(table continued next page)

GS10 Parameters Summary – Special Parameters (P07.xx) – (continued)							
Parameter		***Range***	***Run* Read/ Write***	***Modbus Address***		***Settings***	
				Hex	***Dec***	***Default***	***User***
P07.38	PMSVC voltage feed forward gain	0.50–2.00	R/W	0726	41831	1.00	
P07.62	dEb gain (Kp)	0–65535	♦R/W	073E	41855	8000	
P07.63	dEb gain (Ki)	0–65535	♦R/W	073F	41856	150	
P07.71	Torque compensation gain (motor 2)	IM: 0–10 (when P05.33 = 0) PM: 0–5000 (when P05.33 = 1 or 2)	♦R/W	0747	41864	1	
P07.72	Slip compensation gain (motor 2)	0.00–10.00	♦R/W	0748	41865	0.00 (Default value is 1.00 in SVC mode)	
P07.84	Flaying catch retry time	0–65535 sec.	♦R/W	0754	41877	0	
P07.85	Magnetization time	0–65535	♦R/W	0755	41878	0	

High-Function PID Parameters Summary (P08.xx)

For detailed information about the P08.xx parameter group, please refer to *page 4–173*.

GS10 Parameters Summary – High-Function PID Parameters (P08.xx)							
Parameter		**Range**	**Run[1] Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default[2]**	**User**
1) ♦ in the Run-Read/Write column indicates that the parameter can be set during RUN mode. R/W indicates "Read/Write." Read indicates "Read-only." *2) Parameters can be restored to their default values using P00.02.*							
P08.00	Terminal selection of PID feedback	0: No function 1: Negative PID feedback: by analog input (P03.00) 4: Positive PID feedback: by analog input (P03.00) 7: Negative PID feedback: by communication protocols 8: Positive PID feedback: by communication protocols	♦R/W	0800	42049	0	
P08.01	Proportional gain (P)	0.0–1000.0 (When P08.23 bit 1=0) 0.00–100.00 (When P08.23 bit 1=1)	♦R/W	0801	42050	1.00	
P08.02	Integral time (I)	0.00–100.00 sec.	♦R/W	0802	42051	1.00	
P08.03	Differential time (D)	0.00–1.00 sec.	♦R/W	0803	42052	0.00	
P08.04	Upper limit of integral control	0.0–100.0%	♦R/W	0804	42053	100.0	
P08.05	PID output command limit (positive limit)	0.0–110.0%	♦R/W	0805	42054	100.0	
P08.06	PID feedback value by communication protocol	-200.00–200.00%	♦R/W	0806	42055	0.00	
P08.07	PID delay time	0.0–2.5 sec.	♦R/W	0807	42056	0.0	
P08.08	Feedback signal detection time	0.0–3600.0 sec.	♦R/W	0808	42057	0.0	
P08.09	Feedback signal fault treatment	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: Warn and operate at last frequency	♦R/W	0809	42058	0	
P08.10	Sleep frequency	0.00–599.0 Hz	♦R/W	080A	42059	0.00	
P08.11	Wake-up frequency	0.00–599.0 Hz	♦R/W	080B	42060	0.00	
P08.12	Sleep time	0.0–6000 sec.	♦R/W	080C	42061	0.0	
P08.13	PID feedback signal error deviation level	1.0–50.0%	♦R/W	080D	42062	10.0	
P08.14	PID feedback signal error deviation detection time	0.1–300.0 sec.	♦R/W	080E	42063	5.0	
P08.15	PID feedback signal filter time	0.1–300.0 sec.	♦R/W	080F	42064	5.0	
P08.16	PID compensation selection	0: Parameter setting 1: Analog input	♦R/W	0810	42065	0	
P08.17	PID compensation	-100.0–100.0%	♦R/W	0811	42066	0	
P08.18	Sleep mode function setting	0: Refer to PID output command 1: Refer to PID feedback signal	R/W	0812	42067	0	
P08.19	Wake-up integral limit	0.0–200.0%	♦R/W	0813	42068	50.0	
P08.20	PID mode selection	0: Dependent ISA PID structure 1: Independent ISA PID structure	R/W	0814	42069	0	
P08.21	Enable PID to change the operation direction	0: Operation direction cannot be changed 1: Operation direction can be changed	R/W	0815	42070	0	
P08.22	Wake-up delay time	0.00–600.0 sec.	♦R/W	0816	42071	0.00	
(table continued next page)							

GS10 Parameters Summary – High-Function PID Parameters (P08.xx) – (continued)							
Parameter		***Range***	***Run* Read/ Write***	***Modbus Address***		***Settings***	
				Hex	***Dec***	***Default***	***User***
P08.23	PID control flag	bit 0 = 1: PID running in reverse follows the setting for P00.23. bit 0 = 0: PID running in reverse refers to PID's calculated value. bit 1 = 1: two decimal places for PID Kp bit 1 = 0: one decimal place for PID Kp	♦R/W	0817	42072	2	
P08.26	PID output command limit (reverse limit)	0.0–100.0%	♦R/W	081A	42075	100.0	
P08.27	Acceleration / deceleration time for PID command	0.00–655.35 sec.	♦R/W	081B	42076	0.00	
P08.31	Proportional gain 2	0.0–1000.0 (when P08.23 setting bit1=0) 0.00–100.00 (when P08.23 setting bit1=1)	♦R/W	081F	42080	1.00	
P08.32	Integral time 2	0.00–100.00 sec.	♦R/W	0820	42081	1.00	
P08.33	Differential time 2	0.00–1.00 sec.	♦R/W	0821	42082	0.00	
P08.61	Feedback of PID physical quantity value	1.0–99.9	R/W	083D	42110	99.9	
P08.62	Treament of the erroneous PID feedback level	0: Warn and keep operating (no treatment) 1: Fault and coast to stop 2: Fault and ramp to stop 3: Ramp to stop and restart after time set at P08.63 (without displaying fault and warning) 4: Ramp to stop and restart after time set at P08.63. The number of times of restart depends on the setting for P08.64.	R/W	083E	42111	0	
P08.63	Delay time for restart of erroneous PID deviation level	1–9999 sec	R/W	083F	42112	60	
P08.64	Number of times of restart after PID error	0–1000 times	♦R/W	0840	42113	0	
P08.65	PID target value source	0: Frequency command (P00.20, P00.30) 1: P08.66 setting 2: RS-485 communication input 3: External analog input (refer to P03.00) 7: Digital keypad potentiometer dial	♦R/W	0841	42114	0	
P08.66	PID target value setting	-100.00–100.00%	♦R/W	0842	42115	50.00	
P08.67	Master and auxiliary reverse running cutoff frequency	0.0–100.0%	♦R/W	0843	42116	10.0	
P08.68	PID deviation limit	0.00–100.00%	♦R/W	0844	42117	0.00	
P08.69	Integral separation level	0.00–100.00%	♦R/W	0845	42118	0.00	
P08.70	Smart start-up level	0.00–100.00%	R/W	0846	42119	5.00	
P08.71	Smart start-up frequency command	0.00–599.0 Hz	♦R/W	0847	42120	0.00	
P08.72	Smart start-up acceleration time	0.00–600.0 sec.	♦R/W	0848	42121	3.00	
P08.75	PID2 parameter switch condition	0: No switching (refer to P08.01–P08.03) 1: Auto-switch based on the output frequency 2: Auto-switch based on the deviation	♦R/W	084B	42124	0	
P08.76	PID2 parameter switch deviation 1	0.00–P08.77%	♦R/W	084C	42125	10.00	

(table continued next page)

GS10 Parameters Summary – High-Function PID Parameters (P08.xx) – (continued)							
Parameter		Range	Run* Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P08.77	PID2 parameter switch deviation 2	P08.76–100.00%	♦R/W	084D	42126	40.00	
P08.78	Allowed reverse running time after start-up	0.0–6553.5 sec.	♦R/W	084E	42127	0.0	

Communication Parameters Summary (P09.xx)

For detailed information about the P09.xx parameter group, please refer to *page 4–188*.

GS10 Parameters Summary – Communication Parameters (P09.xx)							
Parameter		***Range***	***Run[1)] Read/ Write***	***Modbus Address***		***Settings***	
				Hex	***Dec***	***Default[2)]***	***User***
1) ♦ in the Run-Read/Write column indicates that the parameter can be set during RUN mode. R/W indicates "Read/Write." Read indicates "Read-only." 2) Parameters can be restored to their default values using P00.02.							
P09.00	Communication address	1–254	♦R/W	0900	42305	1	
P09.01	COM1 transmission speed	4.8–38.4 Kbps	♦R/W	0901	42306	38.4	
P09.02	COM1 transmission fault treatment	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning, no fault, and continue operation	♦R/W	0902	42307	3	
P09.03	COM1 time-out detection	0.0–100.0 sec.	♦R/W	0903	42308	0.0	
P09.04	COM1 communication protocol	1: 7, N, 2 (ASCII) 2: 7, E, 1 (ASCII) 3: 7, O, 1 (ASCII) 4: 7, E, 2 (ASCII) 5: 7, O, 2 (ASCII) 6: 8, N, 1 (ASCII) 7: 8, N, 2 (ASCII) 8: 8, E, 1 (ASCII) 9: 8, O, 1 (ASCII) 10: 8, E, 2 (ASCII) 11: 8, O, 2 (ASCII) 12: 8, N, 1 (RTU) 13: 8, N, 2 (RTU) 14: 8, E, 1 (RTU) 15: 8, O, 1 (RTU) 16: 8, E, 2 (RTU) 17: 8, O, 2 (RTU)	♦R/W	0904	42309	13	
P09.09	Communication response delay time	0.0–200.0 ms	♦R/W	0909	42314	2.0	
P09.10	Communication main frequency	0.00–599.0 Hz	R/W	090A	42315	60.00	
P09.11	Block transfer 1	0–65535	♦R/W	090B	42316	0	
P09.12	Block transfer 2	0–65535	♦R/W	090C	42317	0	
P09.13	Block transfer 3	0–65535	♦R/W	090D	42318	0	
P09.14	Block transfer 4	0–65535	♦R/W	090E	42319	0	
P09.15	Block transfer 5	0–65535	♦R/W	090F	42320	0	
P09.16	Block transfer 6	0–65535	♦R/W	0910	42321	0	
P09.17	Block transfer 7	0–65535	♦R/W	0911	42322	0	
P09.18	Block transfer 8	0–65535	♦R/W	0912	42323	0	
P09.19	Block transfer 9	0–65535	♦R/W	0913	42324	0	
P09.20	Block transfer 10	0–65535	♦R/W	0914	42325	0	
P09.21	Block transfer 11	0–65535	♦R/W	0915	42326	0	
P09.22	Block transfer 12	0–65535	♦R/W	0916	42327	0	
P09.23	Block transfer 13	0–65535	♦R/W	0917	42328	0	
P09.24	Block transfer 14	0–65535	♦R/W	0918	42329	0	
P09.25	Block transfer 15	0–65535	♦R/W	0919	42330	0	
P09.26	Block transfer 16	0–65535	♦R/W	091A	42331	0	
P09.30	Communication decoding method	0: Decoding method 1 1: Decoding method 2	R/W	091E	42335	0	

GS10 Parameters Summary – Communication Parameters (P09.xx) – (continued)							
Parameter		**Range**	**Run* Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P09.31	Internal Communication Protocol	0: modbus 485 -21: Pump Master -22: Pump Slave 1 -23: Pump Slave 2 -24: Pump Slave 3	R/W	0920	42336	0	

Speed Feedback Control Parameters Summary (P10.xx)

For detailed information about the P10.xx parameter group, please refer to page 4–201.

GS10 Parameters Summary – Speed Feedback Control Parameters (P10.xx)							
Parameter		**Range**	**Run[1)] Read/ Write**	**Modbus Address Hex**	**Dec**	**Settings Default[2)]**	**User**
1) ♦ in the Run-Read/Write column indicates that the parameter can be set during RUN mode. R/W indicates "Read/Write." Read indicates "Read-only." 2) Parameters can be restored to their default values using P00.02.							
P10.16	Pulse input type setting	0: Disabled 5: Single-phase input (DI5) 6: PWM signal input	♦R/W	0A10	42577	0	
P10.29	Upper limit of frequency deviation	0.00–200.00 Hz	♦R/W	0A1D	42590	20.00	
P10.31	I/F mode, current command	0–150% rated current of the motor	♦R/W	0A1F	42592	40	
P10.32	PM sensorless speed estimator bandwidth	0.00–600.0 Hz	♦R/W	0A20	42593	5.00	
P10.34	PM sensorless speed estimator low-pass filter gain	0.00–655.35	♦R/W	0A22	42595	1.00	
P10.42	Initial angle detection pulse value	0.0–3.0	♦R/W	0A2A	42603	1.0	
P10.49	Zero voltage time during start-up	0.000–60.000 sec.	♦R/W	0A31	42610	0.000	
P10.51	Injection frequency	0–1200 Hz	♦R/W	0A33	42612	500	
P10.52	Injection magnitude	120V / 230V models: 100.0 V 460V models: 200.0 V Note: The setting range varies depending on the voltage.	♦R/W	0A34	42613	15.0 30.0	
P10.53	Angle detection method	0: Disabled 1: Force attracting the rotor to zero degrees 2: High frequency injection 3: Pulse injection	♦R/W	0A35	42614	0	

Advanced Parameters Summary (P11.xx)

For detailed information about the P11.xx parameter group, please refer to *page 4–205*.

GS10 Parameters Summary – Advanced Parameters (P11.xx)							
Parameter		***Range***	***Run[1] Read/ Write***	***Modbus Address***		***Settings***	
				Hex	***Dec***	***Default[2]***	***User***
1) ♦ in the Run-Read/Write column indicates that the parameter can be set during RUN mode. R/W indicates "Read/Write." Read indicates "Read-only." 2) Parameters can be restored to their default values using P00.02.							
P11.00	System control	bit 0: Auto-tuning for ASR bit 3: Dead time compensation closed bit 7: Save or do not save the frequency	R/W	0B00	42817	0	
P11.41	PWM mode selection	0: Two-phase modulation mode (DPWM) 2: Space vector modulation mode (SVPWM)	R/W	0B29	42858	2	
P11.42	System control flag	0000–FFFFh	♦R/W	0B2A	42859	0000	

Function Parameters (P12.xx)

For detailed information about the P12.xx parameter group, please refer to xx.

GS10 Parameters Summary – Function Parameters (P12.xx)							
Parameter		***Range***	***Run[1)] Read/ Write***	***Modbus Address***		***Settings***	
				Hex	***Dec***	***Default[2)]***	***User***
1) ♦ in the Run-Read/Write column indicates that the parameter can be set during RUN mode. R/W indicates "Read/Write." Read indicates "Read-only." 2) Parameters can be restored to their default values using P00.02.							
P12.00	Set point deviation level	0–100%	♦R/W	0C00	43073	0	
P12.01	Detection time of set point deviation level	1–9999 sec.	♦R/W	0C01	43074	10	
P12.02	Offset level of liquid leakage	0–50%	♦R/W	0C02	43075	0	
P12.03	Liquid leakage change detection	0: Disable 0–100%	♦R/W	0C03	43076	0	
P12.04	Time setting for liquid leakage change	0: Disable 0.1–10.0 sec.	♦R/W	0C04	43077	0.5	
P12.05	Multi-pump control mode	0: Disable 1: Fixed time circulation (alternative operation) 2: Fixed quantity control (multi-pump operating at constant pressure)	R/W	0C05	43078	0	
P12.07	Multi-pump's fixed time circulation period	1–65535 (minute)	♦R/W	0C07	43080	60	
P12.08	Frequency to start switching pumps	0.00 Hz–FMAX (P01.00)	♦R/W	0C08	43081	60.00	
P12.09	Time detected when pump reaches the starting frequency	0.0–3600.0 sec.	♦R/W	0C09	43082	1.0	
P12.10	Frequency to stop switching pumps	0.00 Hz–FMAX (P01.00)	♦R/W	0C0A	43083	48.00	
P12.11	Time detected when pump reaches the stopping frequency	0.0–3600.0 sec.	♦R/W	0C0B	43084	1.0	
P12.12	Pump's frequency at time-out (disconnection)	0.00–FMAX (P01.00)	♦R/W	0C0C	43085	0.00	
P12.13	Pump's error treatment	bit0: whether to switch to an alternative pump when operation pump error occurred. 0: Stop all pump actions. 1: Switch to an alternative pump. bit1: Standby or stop after resetting from error. 0: Standby after reset. 1: Stop after reset. bit2: To run a pump or not when an error is occurred. 0: Do not start. 1: Select an alternative pump.	R/W	0C0D	43086	1	
P12.14	Selection of pump start-up sequence	0: By pump's ID # 1: By the running time.	R/W	0C0E	43087	1	
P12.15	Running time of multi-pump under alternative operation	0.0–360.0 sec.	♦R/W	0C0F	43088	60.0	
P12.20	Simple positioning stop frequency 0	0.00–599.0 Hz	♦R/W	0C14	43093	0.00	
P12.21	Simple positioning stop frequency 1	0.00–599.0 Hz	♦R/W	0C15	43094	5.00	

(table continued next page)

GS10 Parameters Summary – Advanced Parameters (P11.xx) – (continued)							
Parameter		***Range***	***Run* Read/ Write***	***Modbus Address***		***Settings***	
				Hex	***Dec***	***Default***	***User***
P12.22	Simple positioning stop Frequency 2	0.00–599.0 Hz	♦R/W	0C16	43095	10.00	
P12.23	Simple positioning stop frequency 3	0.00–599.0 Hz	♦R/W	0C17	43096	20.00	
P12.24	Simple positioning stop frequency 4	0.00–599.0 Hz	♦R/W	0C18	43097	30.00	
P12.25	Simple positioning stop frequency 5	0.00–599.0 Hz	♦R/W	0C19	43098	40.00	
P12.26	Simple positioning stop frequency 6	0.00–599.0 Hz	♦R/W	0C1A	43099	50.00	
P12.27	Simple positioning stop frequency 7	0.00–599.0 Hz	♦R/W	0C1B	43100	60.00	
P12.28	Delay time of simple positioning stop 0	0.00–600.0 sec.	♦R/W	0C1C	43101	0.00	
P12.29	Delay time of simple positioning stop 1	0.00–600.0 sec.	♦R/W	0C1D	43102	0.00	
P12.30	Delay time of simple positioning stop 2	0.00–600.0 sec.	♦R/W	0C1E	43103	0.00	
P12.31	Delay time of simple positioning stop 3	0.00–600.0 sec.	♦R/W	0C1F	43104	0.00	
P12.32	Delay time of simple Positioning Stop 4	0.00–600.0 sec.	♦R/W	0C20	43105	0.00	
P12.33	Delay time of simple positioning stop 5	0.00–600.0 sec.	♦R/W	0C21	43106	0.00	
P12.34	Delay time of simple positioning stop 6	0.00–600.0 sec.	♦R/W	0C22	43107	0.00	
P12.35	Delay time of simple positioning stop 7	0.00–600.0 sec.	R/W	0C23	43108	0.00	
P12.40	Automatic operation mode	0: Disable operation 1: Execute one program cycle 2: Continuously execute program cycles 3: Execute one program cycle step by step 4: Continuously execute one program cycle step by step 5: Disable automatic operation, but the direction setting at multi-step speed 1 to 8 are effective	R/W	0C28	43113	0	
P12.41	Automation operation program running direction mode	bit 0–bit 7 (0: FWD RUN, 1: REV RUN) bit 0: Direction of auto-operation's main speed bit 1: Direction of the first speed for P04.00 bit 2: Direction of the second speed for P04.01 bit 3: Direction of the third speed for P04.02 bit 4: Direction of the fourth speed for P04.03 bit 5: Direction of the fifth speed for P04.04 bit 6: Direction of the sixith speed for P04.05 bit 7: Direction of the seventh speed for P04.06	R/W	0C29	43114	0	
P12.42	Main frequency time setting	0–65500 sec.	R/W	0C2A	43115	0	
P12.43	1st speed time setting	0–65500 sec.	R/W	0C2B	43116	0	

(table continued next page)

GS10 Parameters Summary – Advanced Parameters (P11.xx) – (continued)							
Parameter		***Range***	***Run* Read/ Write***	***Modbus Address***		***Settings***	
				Hex	***Dec***	***Default***	***User***
P12.44	2nd speed time setting	0–65500 sec.	R/W	0C2C	43117	0	
P12.45	3rd speed time setting	0–65500 sec.	R/W	0C2D	43118	0	
P12.46	4th speed time setting	0–65500 sec.	R/W	0C2E	43119	0	
P12.47	5th speed time setting	0–65500 sec.	R/W	0C2F	43120	0	
P12.48	6th speed time setting	0–65500 sec.	R/W	0C30	43121	0	
P12.49	7th speed time setting	0–65500 sec.	R/W	0C31	43122	0	
P12.51	Average PWM signal	1–100 times	♦R/W	0C33	43124	1	
P12.52	PWM signal period	1–2000 ms	♦R/W	0C34	43125	1	

Macro / User Defined Macro Parameters Summary (P13.xx)

For detailed information about the P13.xx parameter group, please refer to *page 4–218.*

GS10 Parameters Summary – Macro / User-Defined Macro Parameters (P13.xx)							
Parameter		**Range**	**Run[1] Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default[2]**	**User**
1) ♦ in the Run-Read/Write column indicates that the parameter can be set during RUN mode. R/W indicates "Read/Write." Read indicates "Read-only." 2) Parameters can be restored to their default values using P00.02.							
P13.00	Industry-specific parameter application	00: Disabled 01: User-defined parameter 03: Fan 04: Pump 05: Conveyor 07: Packing 10: Logistics 11: PID 12: PID + Auxillary	R/W	0D0D	43329	00	
P13.01	User-defined parameter			0D01	43330		
P13.02	User-defined parameter			0D02	43331		
P13.03	User-defined parameter			0D03	43332		
P13.04	User-defined parameter			0D04	43333		
P13.05	User-defined parameter			0D05	43334		
P13.06	User-defined parameter			0D06	43335		
P13.07	User-defined parameter			0D07	43336		
P13.08	User-defined parameter			0D08	43337		
P13.09	User-defined parameter			0D09	43338		
P13.10	User-defined parameter			0D0A	43339		
P13.11	User-defined parameter			0D0B	43340		
P13.12	User-defined parameter			0D0C	43341		
P13.13	User-defined parameter			0D0D	43342		
P13.14	User-defined parameter			0D0E	43343		
P13.15	User-defined parameter			0D0F	43344		
P13.16	User-defined parameter			0D10	43345		
P13.17	User-defined parameter			0D11	43346		
P13.18	User-defined parameter			0D12	43347		
P13.19	User-defined parameter			0D13	43348		
P13.20	User-defined parameter			0D14	43349		
P13.21	User-defined parameter			0D15	43350		
P13.22	User-defined parameter			0D16	43351		
P13.23	User-defined parameter			0D17	43352		
P13.24	User-defined parameter			0D18	43353		
P13.25	User-defined parameter			0D19	43354		
P13.26	User-defined parameter			0D1A	43355		
P13.27	User-defined parameter			0D1B	43356		
P13.28	User-defined parameter			0D1C	43357		
P13.29	User-defined parameter			0D1D	43358		
P13.30	User-defined parameter			0D1E	43359		
P13.31	User-defined parameter			0D1F	43360		
P13.32	User-defined parameter			0D20	43361		
P13.33	User-defined parameter			0D21	43362		
P13.34	User-defined parameter			0D22	43363		
P13.35	User-defined parameter			0D23	43364		
P13.36	User-defined parameter			0D24	43365		
P13.37	User-defined parameter			0D25	43366		
P13.38	User-defined parameter			0D26	43367		

GS10 Parameters Summary – Macro / User-Defined Macro Parameters (P13.xx) – (continued)							
Parameter		**Range**	**Run* Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P13.39	User-defined parameter			0D27	43368		
P13.40	User-defined parameter			0D28	43369		
P13.41	User-defined parameter			0D29	43370		
P13.42	User-defined parameter			0D2A	43371		
P13.43	User-defined parameter			0D2B	43372		
P13.44	User-defined parameter			0D2C	43373		
P13.45	User-defined parameter			0D2D	43374		
P13.46	User-defined parameter			0D2E	43375		
P13.47	User-defined parameter			0D2F	43376		
P13.48	User-defined parameter			0D30	43377		
P13.49	User-defined parameter			0D31	43378		
P13.50	User-defined parameter			0D32	43379		

Protection Parameters (2) Summary (P14.xx)

For detailed information about the P14.xx parameter group, please refer to page 4–229.

GS10 Parameters Summary – Protection Parameters (2) (P14.xx)							
Parameter		Range	Run[1] Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default[2]	User
1) ♦ in the Run-Read/Write column indicates that the parameter can be set during RUN mode. R/W indicates "Read/Write." Read indicates "Read-only." 2) Parameters can be restored to their default values using P00.02.							
P14.50	Output frequency at malfunction 2	0.00–599.0 Hz	Read	0E32	43635	0	
P14.51	DC bus voltage at malfunction 2	0.0–6553.5 V	Read	0E33	43636	0	
P14.52	Output current at malfunction 2	0.00–655.35 Amp	Read	0E34	43637	0	
P14.53	IGBT temperature at malfunction 2	-3276.7–3276.7°C	Read	0E35	43638	0	
P14.54	Output frequency at malfunction 3	0.00–599.0 Hz	Read	0E36	43639	0	
P14.55	DC bus voltage at malfunction 3	0.0–6553.5 V	Read	0E37	43640	0	
P14.56	Output current at malfunction 3	0.00–655.35 Amp	Read	0E38	43641	0	
P14.57	IGBT temperature at malfunction 3	-3276.7–3276.7°C	Read	0E39	43642	0	
P14.58	Output frequency at malfunction 4	0.00–599.0 Hz	Read	0E3A	43643	0	
P14.59	DC bus voltage at malfunction 4	0.0–6553.5 V	Read	0E3B	43644	0	
P14.60	Output current at malfunction 4	0.00–655.35 Amp	Read	0E3C	43645	0	
P14.61	IGBT temperature at malfunction 4	-3276.7–3276.7°C	Read	0E3D	43646	0	
P14.62	Output frequency at malfunction 5	0.00–599.0 Hz	Read	0E3E	43647	0	
P14.63	DC bus voltage at malfunction 5	0.0–6553.5 V	Read	0E3F	43648	0	
P14.64	Output current at malfunction 5	0.00–655.35 Amp	Read	0E40	43649	0	
P14.65	IGBT temperature at malfunction 5	-3276.7–3276.7°C	Read	0E41	43650	0	
P14.66	Output frequency at malfunction 6	0.00–599.0 Hz	Read	0E42	43651	0	
P14.67	DC bus voltage at malfunction 6	0.0–6553.5 V	Read	0E43	43652	0	
P14.68	Output current at malfunction 6	0.00–655.35 Amp	Read	0E44	43653	0	
P14.69	IGBT temperature at malfunction 6	-3276.7–3276.7°C	Read	0E45	43654	0	
P14.70	Fault record 7	Refer to fault record P06.17–P06.22	Read	0E46	43655	0	
P14.71	Fault record 8	Refer to fault record P06.17–P06.22	Read	0E47	43656	0	
P14.72	Fault record 9	Refer to fault record P06.17–P06.22	Read	0E48	43657	0	
P14.73	Fault record 10	Refer to fault record P06.17–P06.22	Read	0E49	43658	0	

NOTE: For Command and Status addresses (2000h-2200h), refer to page 4-195.

DURApulse GS10 Parameter Details

Explanation of Parameter Details format

		Type	Hex Addr	Dec Addr
Pxx.xx	**Descriptive Parameter Name**	♦R/W	xxxx	4xxxx
	Range/Units	Default		
	xx~xxx.xx	xx		

Where:

- *Pxx.xx* = Parameter number, followed by descriptive parameter name
- *Type* = Parameter type (♦R/W)
  - ♦ = Parameter can be set while drive is in run mode
  - R/W = Read/Write parameter
  - Read = Read-only; parameter can be read from, but not written to
- *Hex Addr* = Hexadecimal parameter address
- *Dec Addr* = Modbus decimal parameter address
- *Range/Units* = Range of parameter settings, including units if applicable
- *Default* = Parameter default setting
  (Parameters can be restored to their default values using P00.02.)

Group P00.xx Details – Drive Parameters

		Type	Hex Addr	Dec Addr
P00.00	**GS10 Model ID**	Read	0000	40001
	Range/Units (Format: 16-bit unsigned)	Default		
	102: 120 V, 1 Phase, 0.25 HP 103: 120 V, 1 Phase, 0.5 HP 104: 120 V, 1 Phase, 1 HP 302: 230 V, 1 Phase, 0.25 HP 303: 230 V, 1 Phase, 0.5 HP 304: 230 V, 1 Phase, 1 HP 305: 230 V, 1 Phase, 2 HP 306: 230 V, 1 Phase, 3 HP 202: 230 V, 3 Phase, 0.25 HP 203: 230 V, 3 Phase, 0.5 HP 204: 230 V, 3 Phase, 1 HP 205: 230 V, 3 Phase, 2 HP 206: 230 V, 3 Phase, 3 HP 207: 230 V, 3 Phase, 5 HP 208: 230 V, 3 Phase, 7.5 HP 403: 460 V, 3 Phase, 0.5 HP 404: 460 V, 3 Phase, 1 HP 405: 460 V, 3 Phase, 2 HP 406: 460 V, 3 Phase, 3 HP 407: 460 V, 3 Phase, 5 HP 408: 460 V, 3 Phase, 7.5 HP 409: 460 V, 3 Phase, 10 HP	0		

P00.00 displays a code that corresponds to the voltage, phase, and horsepower rating of the GS10 drive.

		Type	Hex Addr	Dec Addr
P00.01	**GS10 Drive Rated Amps**	Read	0001	40002
	Range/Units (Format: 16-bit unsigned)	Default		
	Display by models	0		

P00.01 displays rated current in amps for the drive. By default this displays the value for constant torque. Set P00.16=0 to display the variable torque rating instead.

		Type	Hex Addr	Dec Addr
P00.02	**Restore to Default**	R/W	0002	40003
	Range/Units (Format: 16-bit binary)	Default		
	0: No function 1: Parameter Lock 5: Reset kWh Display to 0 8: Disable Keypad Run 9: Reset all parameters to 50Hz defaults 10: Reset all parameters to 60Hz defaults 11: Reset all parameters to 50Hz defaults (retain user-defined parameter values P13.01~P13.50) 12: Reset all parameters to 60Hz defaults (retain user-defined parameter values P13.01~P13.50)	0		

P00.02 allows the resetting of various parameter sets and drive functions.

Setting Explanations

- *P00.02=1, all parameters are set to read only except for P00.02, P00.07, and P00.08. P00.02 must be changed to 0 to change parameter settings.*
- *P00.02=5, returns the kWh displayed value to 0, even during drive operation. For example, P05.26 accumulated W-s will be set to zero.*
- *P00.02=8, disables the RUN key on the drive keypad.*
- *P00.02=9, resets all parameters to default for base frequency of 50Hz.*
- *P00.02=10, resets all parameters to default for base frequency of 60Hz.*
- *P00.02=11, resets all parameters to default for base frequency of 50Hz, but keeps any user-defined parameter values (P13.01 through P13.50).*
- *P00.02=12, resets all parameters to default for base frequency of 60Hz, but keeps any user-defined parameter values (P13.01 through P13.50).*
- *If a password has been set using P00.08, you must unlock and clear the password (P00.07) before resetting parameters.*

NOTE: For settings 9, 10, 11, and 12 you must reboot the drive after adjusting the setting to enable the change.

		Type	Hex Addr	Dec Addr
P00.03	**Start-up Display Selection**	♦R/W	0003	40004
	Range/Units (Format: 16-bit binary)	Default		
	0: F – Freq Setpoint	0		
	1: H – Output Hz			
	2: U - User Display (P00.04)			
	3: A – Output Amps			

P00.03 determines the start-up display page when the drive is powered on. The user-defined contents display according to the P00.04 settings.

		Type	Hex Addr	Dec Addr
P00.04	***User Display***	♦R/W	0004	40005

Range/Units (Format: 16-bit binary) — *Default*: 3

0: Output Amps (A) (unit: Amp)
1: Counter Value (c) (unit: CNT)
2: Output Frequency (H.) (unit: Hz)
3: DC Bus Voltage (V) (unit: VDC)
4: Output Voltage (E) (unit: VAC)
5: Power Factor (n) (unit: deg)
6: Output Power (P) (unit: kW)
7: Calculated RPM (r) (unit: rpm)
8: Output torque (t.) (unit: %)
10: PID Feedback (b) (unit: %)
11: AI-V Analog Input Signal (1.) (unit: %)
12: AI-C Analog Input Signal (2.) (unit: %)
14: IGBT Temperature (i.) (unit: °C)
16: DI Input Status (ON / OFF) (i)
17: DO Output Status (ON / OFF) (o)
18: Multi-Speed Step (S)
19: CPU DI Input Status (d)
20: CPU DO Output Status (0.)
25: Overload count (0.00–100.00%) (o.) (unit: %)
26: Ground fault GFF (G.) (unit: %)
27: DC bus voltage ripple (r.) (unit: VDC)
30: Display the output of User-defined (U)
31: Display P00.05 user gain (K)
36: Present operating carrier frequency of the drive (J.) (Unit: Hz)
38: Display the drive status (6.)
41: kWh display (J) (unit: kWh)
42: PID target value (h.) (unit: %)
43: PID compensation (o.) (unit: %)
44: PID output frequency (b.) (unit: Hz)
46: Auxiliary frequency value (U.) (unit: Hz)
47: Master frequency value (A.) (unit: Hz)
48: Frequency value after addition and subtraction of master and auxiliary frequency (L.) (unit: Hz)
60: Display PID setting and feedback signal
61: Display the content of the running program (1=tt)

P00.04 is used to configure the user display.

Explanation 1

For option 11/12, the display will indicate negative values when setting analog input bias (P03.03 to P03.10).

Example: Assume that AI-V input voltage is 0V, P03.03 is 10.0%, P03.07 is 4 (bias serves as center).

Explanation 2

Example: If DI1 and DI2 are ON, the following table shows the status of the terminals.

Normally opened contact (N.O.): (0: OFF, 1:ON)

Terminal	DI5	DI4	DI3	DI2	DI1
Status	0	0	0	0	1

- *The value is 0000 0000 0010 0001 in binary and 0021H in HEX. When P00.04 is set to 16 or 19, the User Defined Display on the keypad displays 0021h.*

- *Setting 16 is the ON/OFF status of digital input according to P02.12 setting, and setting 19 is the corresponding CPU pin ON/OFF status of the digital input.*
- *When DI1/DI2 default setting is two-wire/three-wire operation control (P02.00≠0) and DI3 is set to three-wire, it is not affected by P02.12.*
- *You can use setting 16 to monitor the digital input ON/OFF status, and then set 19 to check if the circuit is normal.*

Explanation 3

Example: Assume that R1:P02.13 is set to 9 (Drive is ready). After the drive is powered on, if there is no other abnormal status, the contact is ON. The display status is shown below:

Normally opened contact (N.O.):

Terminal	D01	R1
Status	0	1

- *If P00.04 is set to 17 or 20, it displays in hexadecimal "0001h" and the User Defined Display shows ON in the keypad.*
- *Setting 17 is the ON/OFF status of digital output according to P02.18 setting, and setting 20 is the corresponding CPU pin ON/OFF status of the digital output.*
- *You can use setting 17 to monitor the digital output ON/OFF status, and then set 20 to check if the circuit is normal.*

Explanation 4

For setting 25, when the displayed value reaches 100.00%, the drive shows "oL" as an overload warning.

Explanation 5

When set to 38, the bits are defined as follows:

- *Bit 0: The drive is running forward*
- *Bit 1: The drive is running backward*
- *Bit 2: The drive is ready*
- *Bit 3: Errors occurred on the drive*
- *Bit 4: The drive is running*
- *Bit 5: Warnings occurred on the drive*

		Type	*Hex Addr*	*Dec Addr*
P00.05	***Coefficient gain in actual output frequency***	R/W	0005	40006
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–160.00	1.00		

P00.05 is used to set the user-defined coefficient gain. Set P00.04=31 to display the calculation result on the screen (calculation = output frequency x P00.05).

		Type	*Hex Addr*	*Dec Addr*
P00.06	***Firmware Version***	Read	0006	40007
	Range/Units (Format: 16-bit unsigned)	*Default*		
	Read only	0		

P00.06 displays the current firmware version of the drive. Also, check parameter 00.50 for FW date code. Minor updates may only increment a change in date code.

		Type	Hex Addr	Dec Addr
P00.07	***Parameter Protection Password Input***	♦R/W	0007	40008
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–65535 0–4: the number of password attempts allowed	0		

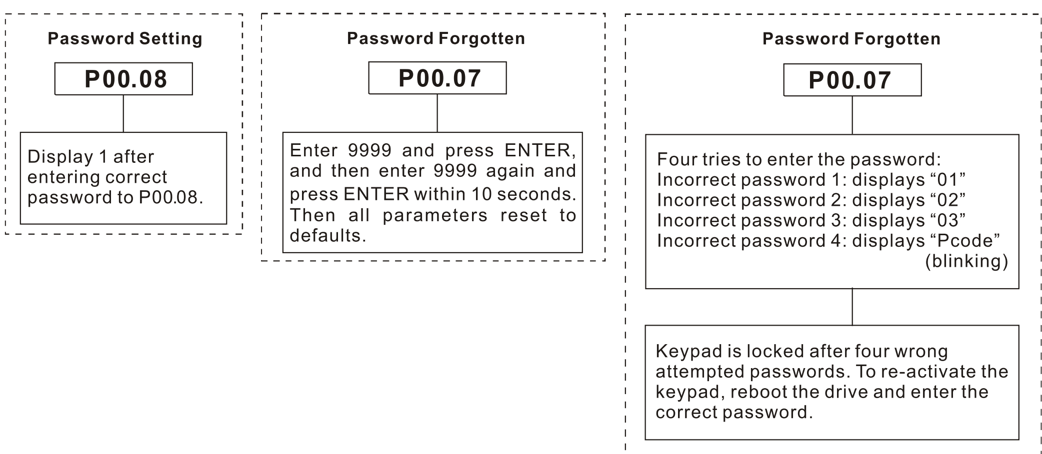
P00.07 allows you to enter the password set via P00.08 to unlock parameter protection and make changes to parameters.

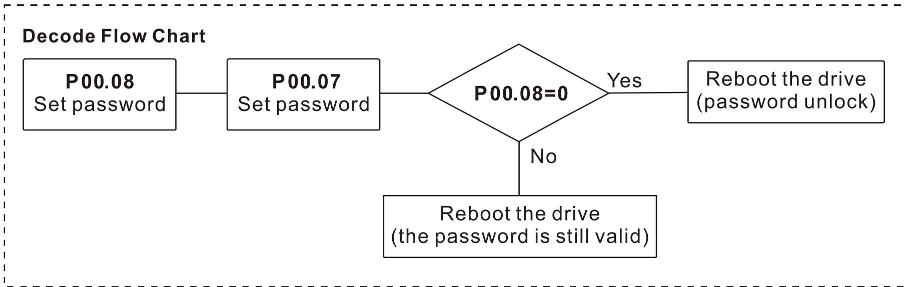
- *P00.07 and P00.08 are used to prevent personnel from accidentally changing parameter values.*
- *When password protection is on, all parameters will read 0 except for P00.08.*
- *Incorrect passwords can be entered up to four times. Each time an incorrect password is entered, the keypad will display the number of incorrect attempts (01, 02, 03). When the final incorrect password is entered, the keypad will flash "Pcode" and the keypad will lock. To re-activate the keypad, reboot the drive and either enter the correct password or reset it.*
- *To reset a forgotten password, input 9999 and press ENTER, then input 9999 again and press ENTER again within 10 seconds. All settings will return to default.*

		Type	Hex Addr	Dec Addr
P00.08	***Parameter Protection Password Setting***	♦R/W	0008	40009
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–65535 0: No password protection or password entered correctly (P00.07) 1: Parameter has been set	0		

P00.08 allows you to set a password to protect parameter settings. If P00.08=1, password protection is active. If P00.08=0, password protection is disabled.

- *To change parameters once a password has been set, you must enter the correct password using P00.07 which temporarily deactivates parameter protection and sets P00.08=0. Once parameter changes are complete, reboot the drive and P00.08 will reset to 1.*
- *To permanently disable the password, manually change P00.08 to 0. Otherwise, password protection is always reactivated after you reboot the motor drive.*
- *The keypad copy function works only when the password protection is deactivated (temporarily or permanently), and the password set in P00.08 cannot be copied to the keypad. So when copying parameters from the keypad to the motor drive, set the password manually again in the motor drive to activate password protection.*





		Type	Hex Addr	Dec Addr
P00.10	***Control Mode***	R/W	000A	40011
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Speed control mode	0		

This selection is not configurable. The GS10 operates in Speed Control mode only.

		Type	Hex Addr	Dec Addr
P00.11	***Speed Control Mode***	R/W	000B	40012
	Range/Units (Format: 16-bit binary)	*Default*		
	0: IMVF (IM V/F control) 2: IM/PM SVC (IM / PM space vector control)	0		

P00.11 determines the speed control mode of the GS10 drive.

Speed control abbreviations:

- *IM = Induction Motor*
- *PM = Permanent Magnet Motor*
- *SVC = Space Vector Control*
- *VF = Volt/Frequency*

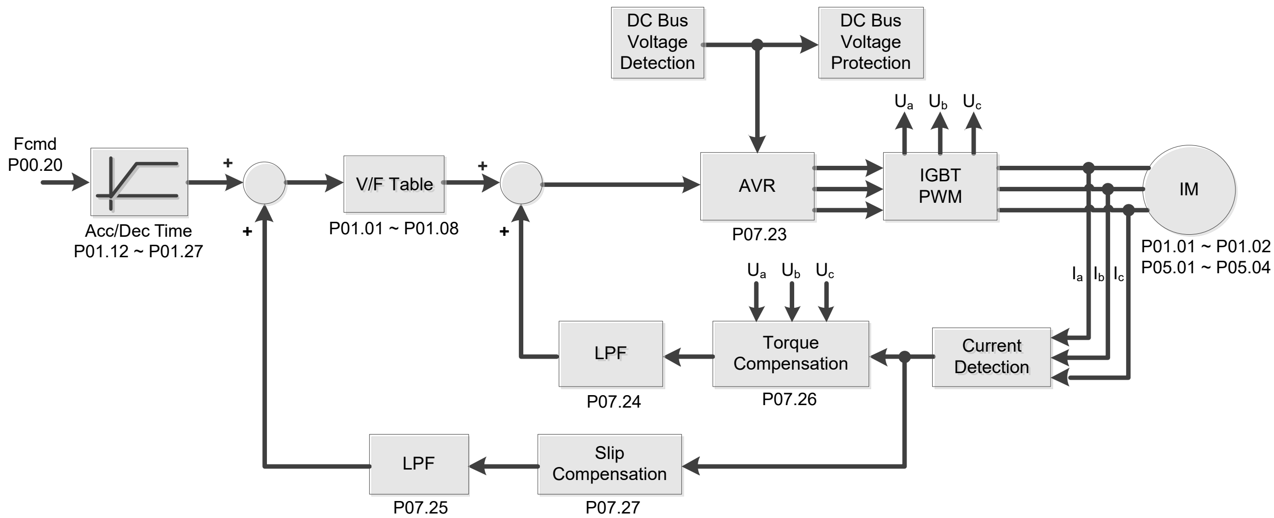
Setting Explanations

- *P00.11=0, drive is set to IM V/F control. You can configure the proportion of V/F as required and control multiple motors simultaneously.*
- *P00.11=2, drive is set to IM/PM space vector control. This auto-tunes motor parameters for optimal control. This is the only control mode that supports permanent magnet motors (IPM or SPM). Set P05.33=1 or 2 for PM motors.*
- *See Adjustments and Applications section on page 4–232 for further info on setting up speed mode for PM motors (PM SVC).*

Control Diagrams

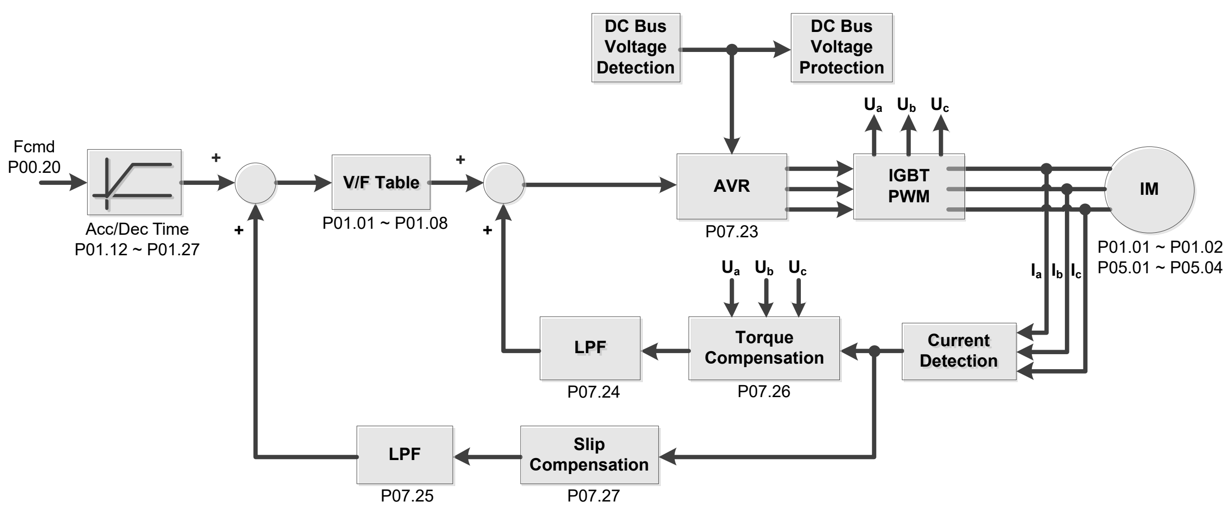
IM V/F Control (IMVF)

When P00.11 is set to 0:IMVF, the V/F control diagram is:



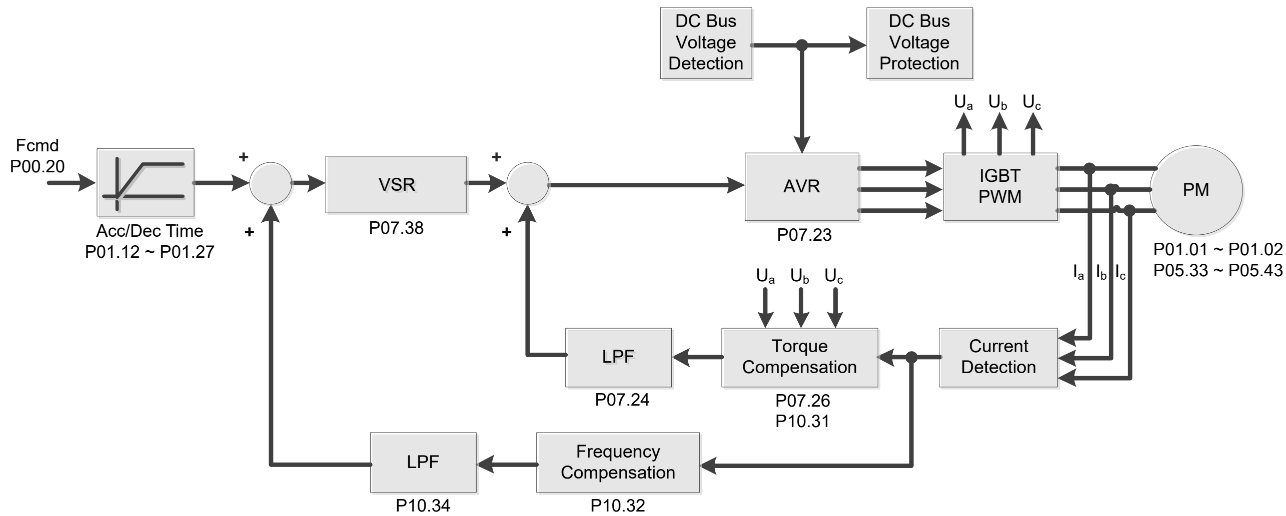
IM Space Vector Control (IMSVC)

When P00.11 is set to 2:IM/PM SVC for an IM motor (P05.33=0), the space vector control diagram is:



PM Space Vector Control (PMSVC)

When P00.11 is set to 2:IM/PM SVC for a PM motor (P05.33=1 or 2), the space vector control diagram is:



See Adjustments and Applications section on page 4–232 for further info on setting up this mode.

		Type	*Hex Addr*	*Dec Addr*
P00.16	***Load Selection***	R/W	0010	40017
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Variable Torque 1: Constant Torque	1		

P00.16 is used to configure the GS10 drive for variable torque or constant torque load.

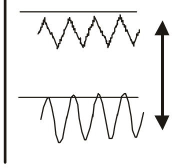
- *Variable Torque (VT): overload rated output current 150% in 3 seconds. (120%, 1 minute). Refer to P00.17 for the setting for the carrier frequency. Refer to Chapter 1 or P00.01 for the rated current.*
- *Constant Torque (CT): overload rated output current 200% in 3 seconds. (150%,1 minute) Refer to P00.17 for the setting for the carrier frequency. Refer to Chapter 1 or P00.01 for the rated current.*
- *P00.01 varies with the set value of P00.16. The default value and maximum of P06.03 and P06.04 also vary with the value of P00.16.*
- *In VT mode, the default setting of P06.03 and P06.04 is 120%, and the maximum is 150%.*
- *In CT mode, the default setting of P06.03 and P06.04 is 180%, and the maximum is 200%.*

		Type	*Hex Addr*	*Dec Addr*
P00.17	***Carrier Frequency***	R/W	0011	40018
	Range/Units (Format: 16-bit unsigned)	*Default*		
	VT: 2–15 kHz CT: 2–15 kHz	4		

P00.17 is used to set the PWM carrier frequency for the GS10 drive. Note that the maximum value is dependent on the horsepower and voltage ratings of the drive.

Model	*Range*
120V, 1/4–1 hp	2–15 kHz
230V, 1/4–15 hp	2–15 kHz
230V, 20–30 hp	2–10 kHz
460V, 1/2–20 hp	2–15 kHz
460V, 25–40 hp	2–10 kHz

The table below shows that the PWM carrier frequency has significant influences on the electromagnetic noise, the AC motor drive heat dissipation, and the motor acoustic noise. Therefore, if the surrounding noise is greater than the motor noise, lower the carrier frequency to reduce the temperature rise. Although the motor has quiet operation in the higher carrier frequency, consider the entire wiring and interference.

Carrier Frequency	Acoustic Noise	Electromagnetic Noise or Leakage Current	Heat Dissipation	Current Wave
2 kHz	Significant	Minimal	Minimal	
8 kHz	↕	↕	↕	
15 kHz	Minimal	Significant	Significant	

When the carrier frequency is higher than the default, decrease the carrier frequency to protect the drive. Refer to P06.55 for the related setting and details.

		Type	Hex Addr	Dec Addr
P00.18	***GS Series Number***	Read	0012	40019
	Range/Units (Format: 16-bit binary)	*Default*		
	10: GS10 series drive (GS11 or GS13)	–		

GS drive series is a read only value that indicates whether the drive is a GS10 or other Durapulse GS model drive.

		Type	Hex Addr	Dec Addr
P00.20	***Master Frequency Command Source (AUTO, REMOTE)***	♦R/W	0014	40021
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Digital keypad 1: RS-485 communication input 2: External analog input (Refer to P03.00) 3: External UP / DOWN terminal (multi-function input terminals) 4: Pulse Input (DI5) without direction command (refer to P10.16 without considering direction) 7: Digital Keypad VR/Potentiometer Dial 9: PID controller Note: HOA (Hand-Off-Auto) function is valid only when you use with DI function setting 41/42 or 56 or with GS4-KPD (optional).	0		

P00.20 determines the master frequency source in the “AUTO, REMOTE" mode. The default is AUTO mode.

- *You can switch the AUTO, REMOTE mode with the keypad GS4-KPD (optional) or the multi-function input terminal (DI) to set the master frequency source.*
- *The drive returns to AUTO or REMOTE mode whenever you cycle the power. If you use a multi-function input terminal to switch between HAND (LOCAL) and AUTO (REMOTE) mode, the highest priority is the multi-function input terminal.*
- *The pulse of P00.20=4 (Pulse input without direction command) is input by DI5 (pulse generator).*
- *If P00.20 is set to 9-PID, P08.65 will automatically set to 1. To change P00.20 from 9 to another value, P08.65 must be changed first (to a value other than 1). We recommend setting P08.65 to 1 first - this will automatically lock P00.20 to a value of 9.*

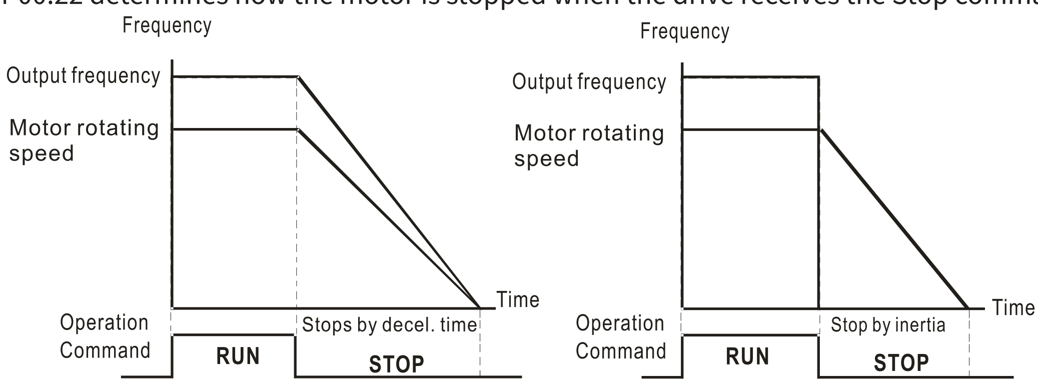
		Type	Hex Addr	Dec Addr
P00.21	***Operation Command Source (AUTO, REMOTE)***	♦R/W	0015	40022
	Range/Units (Format: 16-bit binary)	Default		
	0: Digital keypad 1: External terminals 2: RS-485 communication input Note: HOA (Hand-Off-Auto) function is valid only when you use with DI function setting 41/42 or 56 or with GS4-KPD (optional)	0		

P00.21 determines the operation frequency source in the “AUTO, REMOTE” mode.

- *When Parameter 00.29 is in 0: HOA function, if the multi-function input terminal (DI) function setting 41 and 42 are OFF, the drive does not receive any operation command and JOG is invalid.*
- *The digital keypad is not capable of switching between AUTO and REMOTE. When P00.21=0, the ability to switch is essentially disabled.*

		Type	Hex Addr	Dec Addr
P00.22	***Stop Method***	♦R/W	0016	40023
	Range/Units (Format: 16-bit binary)	Default		
	0: Ramp to stop 1: Coast to stop 2: Motor stops by simple positioning	0		

P00.22 determines how the motor is stopped when the drive receives the Stop command.



1) **Ramp to stop:** According to the set deceleration time, the AC motor drive decelerates to 0 Hz or the minimum output frequency (P01.07), and then stop.
2) **Coast to stop:** According to the load inertia, the AC motor drive stops output immediately, and the motor coasts to stop.

Use “ramp to stop” for the safety of personnel or to prevent material from being wasted in applications where the motor must stop immediately after the drive stops. You must set the deceleration time accordingly.

If idling is allowed or the load inertia is large, use “coast to stop”. For example, blowers, punching machines and pumps.

3) **Motor stops by simple positioning:** use with the functions for P12.20–P12.35.

		Type	Hex Addr	Dec Addr
P00.23	**Motor Direction Control**	♦R/W	0017	40024
	Range/Units (Format: 16-bit binary)	Default		
	0: Enable forward / reverse 1: Disable reverse 2: Disable forward	0		

P00.23 enables the motor to run in the forward and reverse direction. You can use it to prevent a motor from running in a direction that would cause injury or damage to the equipment, especially when only one running direction is allowed for the motor load.

		Type	Hex Addr	Dec Addr
P00.24	**Digital Operator (Keypad) Frequency Command Memory**	Read	0018	40025
	Range/Units (Format: 16-bit unsigned)	Default		
	Read only	0		

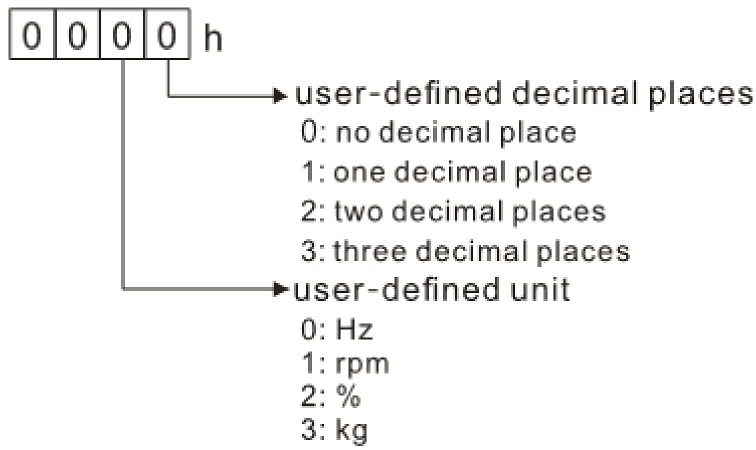
If the keypad is the frequency command source, P00.24 stores the current frequency command when Lv or fault occurs.

		Type	Hex Addr	Dec Addr
P00.25	***User-Defined Characteristics***	♦R/W	0019	40026
	Range/Units (Format: 16-bit binary)	*Default*		
		0		

bit 0–3: user-defined decimal places
0000h, 0000b: no decimal place
0001h, 0001b: one decimal place
0002h, 0010b: two decimal places
0003h, 0011b: three decimal places
bit 4–15: user-defined unit
000xh: Hz
001xh: rpm
002xh: %
003xh: kg
004xh: m/s
005xh: kW
006xh: HP
007xh: ppm
008xh: 1/m
009xh: kg/s
00Axh: kg/m
00Bxh: kg/h
00Cxh: lb/s
00Dxh: lb/m
00Exh: lb/h
00Fxh: ft/s
010xh: ft/m
011xh: m
012xh: ft
013xh: degC
014xh: degF
015xh: mbar
016xh: bar
017xh: Pa
018xh: kPa
019xh: mWG
01Axh: inWG
01Bxh: ftWG
01Cxh: psi
01Dxh: atm
01Exh: L/s
01Fxh: L/m
020xh: L/h
021xh: m3/s
022xh: m3/h
023xh: GPM
024xh: CFM

P00.25 configures the decimal places and units of displayed data.

- *bit 0–3:*
  The displayed units for the control frequency F page and user-defined (P00.04 = d10, PID feedback), and the displayed number of decimal places for P00.26 (support up to three decimal places).
- *bit 4–15:*
  The displayed units for the control frequency F page, user-defined (P00.04 = d10, PID feedback) and P00.26.



- *You must convert the setting value to decimal when using the keypad to set parameters.*

Example:

Assume that the user-defined unit is inWG and user-defined decimal place is the third decimal point. According to the information above, the corresponding unit to inWG is 01Axh (x is the set decimal point), and the corresponding unit to the third decimal place is 0003h, then inWG and the third decimal point displayed in hexadecimal is 01A3h, that is 419 in decimal value. Thus, set P00.25 = 419 to complete the setting.

		Type	*Hex Addr*	*Dec Addr*
P00.26	***Maximum User-Defined Value***	R/W	001A	40027
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0: Disable 0–65535 (when P00.25 is set to no decimal place) 0.0–6553.5 (when P00.25 is set to one decimal place) 0.00–655.35 (when P00.25 is set to two decimal places) 0.000–65.535 (when P00.25 is set to three decimal places)	0		

When P00.26 is NOT set to 0, the user-defined value is enabled. After selecting the displayed unit and number of decimal places with P00.25, the setting value of P00.26 corresponds to P01.00 (drive's maximum operating frequency).

Example:

When the frequency set in P01.00 = 60.00 Hz, the maximum user-defined value for P00.26 is 100.0%. This also means that P00.25 is set at 33 (0021h) to select % as the unit.

Set P00.25 before using P00.26. After you finish setting, when P00.26 is not 0, the displayed unit on the keypad shows correctly according to P00.25 settings.

		Type	*Hex Addr*	*Dec Addr*
P00.27	***User-Defined Value***	Read	001B	40028
	Range/Units (Format: 16-bit signed)	*Default*		
	Read only	0		

P00.27 displays the user-defined value when P00.26 is not set to 0.

The user-defined value is valid only when P00.20 (frequency source) is set to the digital keypad or to RS-485 communication.

		Type	Hex Addr	Dec Addr
P00.29	***LOCAL / REMOTE Selection***	R/W	001D	40030
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Standard HOA function 1: When switching between local and remote, the drive stops. 2: When switching between local and remote, the drive runs with REMOTE settings for frequency and operating status. 3: When switching between local and remote, the drive runs with LOCAL settings for frequency and operating status. 4: When switching between local and remote, the drive runs with LOCAL settings when switched to Local and runs with REMOTE settings when switched to Remote for frequency and operating status.	4		

The default for P00.29 is 4, Local/Remote maintain. Set the Local and Remote frequency and operation source with P00.20, P00.21 and P00.30, P00.31. The external terminal function (DI) = 56 for LOC / REM mode selection is disabled when P00.29=0.

- *If P00.29 is not set to 0, the top right corner of digital keypad GS4-KPD (optional) displays LOC or REM. Set the REMOTE and LOCAL frequency and operation source with P00.20, P00.21 and P00.30, P00.31. Set the multi-function input terminal (DI) = 56 to set the LOC / REM selection. The AUTO key on the GS4-KPD (optional) is the REMOTE function; the HAND key is the LOCAL function.*
- *If P00.29 is not set to 0, the AUTO / HAND keys are disabled. In this case, the external terminal (DI) setting = 56 (local / remote selection) has the highest command priority.*

		Type	Hex Addr	Dec Addr
P00.30	***Master Frequency Command Source (HAND, LOCAL)***	♦R/W	001E	40031
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Digital keypad 1: RS-485 communication input 2: External analog input (refer to P03.00) 3: External UP / DOWN terminal (multi-function input terminals) 4: Pulse input (DI5) without direction command (refer to P10.16 for pulse input config) 7: Digital Keypad VR/Potentiometer Dial 9: PID controller Note: HOA (Hand-Off-Auto) function is valid only when you use with DI function setting 41 or 56 or with GS4-KPD (optional).	0		

P00.30 determines the master frequency source in the "HAND, LOCAL" mode.

- *You can switch the HAND, LOCAL mode with the keypad GS4-KPD (optional) or the multi-function input terminal (DI) to set the master frequency source.*
- *It returns to AUTO or REMOTE mode whenever you cycle the power. If you use a multi-function input terminal to switch between HAND (LOCAL) and AUTO (REMOTE) mode, the highest priority is the multi-function input terminal.*
- *The pulse of P00.30=4 (Pulse input without direction command) is input by DI5 (pulse generator).*
- *If P00.30 is set to 9-PID, P08.65 will automatically set to 1 and P00.20 will set to 9. To change P00.30 from 9 to another value, P08.65 must be changed first (to a value other than 1). Setting P00.30 to 9 only allows PID control frequency from P08.65 and P08.66 for both local and remote drive mode.*

		Type	*Hex Addr*	*Dec Addr*
P00.31	***Operation Command Source (HAND, LOCAL)***	♦R/W	001F	40032
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Digital keypad 1: External terminal 2: RS-485 communication input Note: HOA (Hand-Off-Auto) function is valid only when you use with DI function setting 41/42 or 56 or with GS4-KPD (optional).	0		

P00.31 determines the operation frequency source in the "HAND, LOCAL" mode.

In the HOA mode, if the multi-function input terminal (DI) function setting 41 and 42 are OFF, the drive does not receive any operation command and JOG is invalid

		Type	*Hex Addr*	*Dec Addr*
P00.32	***Digital Keypad STOP Function***	♦R/W	0020	40033
	Range/Units (Format: 16-bit binary)	*Default*		
	0: STOP key disabled 1: STOP key enabled	0		

P00.32 disables or enables the STOP key.

Valid when the operation command source is not the digital keypad (P00.21≠ 0). When P00.21=0, the STOP key on the digital keypad is not affected by this parameter.

		Type	*Hex Addr*	*Dec Addr*
P00.33	***RPWM Mode Selection***	♦R/W	0021	40034
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disabled 1: RPWM mode 1 2: RPWM mode 2 3: RPWM mode 3	0		

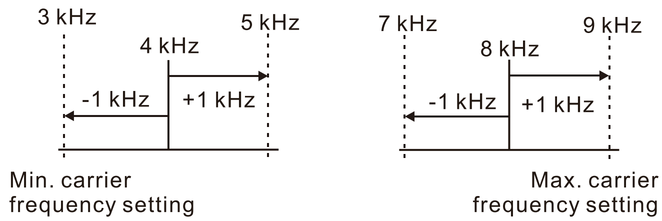
Different control modes for P00.33:

Motor	***Induction Motor (IM)***		***Permanent Magnet Synchronous Motor (PM)***
Control Mode	***VF***	***SVC***	***SVC***
0: RPWM mode 1	✓	✓	✓
1: RPWM mode 2	✓	✓	✓
2: RPWM mode 3	✓	✓	✓

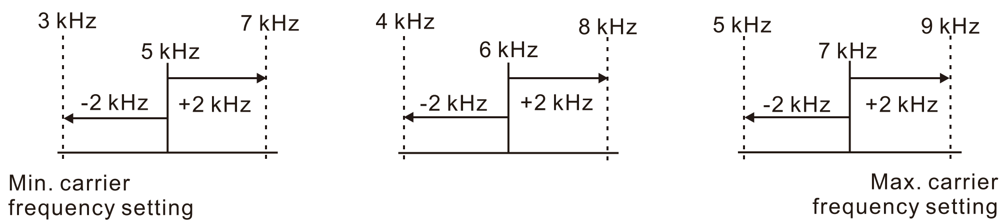
- *When the RPWM function is enabled, the drive randomly distributes the carrier frequency based on actual P00.17 carrier frequency settings.*
- *The RPWM function can be applied to all control modes.*
- *Once the RPWM function is enabled, particularly high frequency audio noise is reduced, and the audio frequency produced by the running motor also changes (usually from a higher to lower).*
- *Three RPWM modes are provided for different applications. Each mode corresponds to different frequency distribution, electromagnetic noise distribution, and audio frequency.*
- *The settings for P00.17 (Carrier Frequency) vary with enabling or disabling RPWM.*

		Type	Hex Addr	Dec Addr
P00.34	***RPWM Range***	♦R/W	0022	40035
	Range/Units (Format: 16-bit binary)	*Default*		
	0.0–4.0 kHz P00.17 = 4kHz, 8kHz: the setting range is 0.0–2.0 kHz P00.17 = 5–7 kHz: the setting range is 0.0–4.0 kHz	0.0		

- *When the RPWM function is enabled, the minimum carrier frequency setting for P00.17 is 3 kHz, and the maximum is 9 kHz.*
- *P00.34 is valid only when the RPWM function is enabled (P00.33 ≠ 0).*
- *When the RPWM function is enabled and P00.17 is set to 4 or 8 kHz, the setting range for P00.34 is 0.0–2.0 kHz (± 1 kHz).*
  Example:
  When P00.17 = 4 kHz, P00.33 is enabled (= 1, 2, or 3), P00.34 = 2.0 kHz, then the carrier frequency outputs on the basis of 4kHz, and the random frequency distribution tolerance is ± 1 kHz, that is, the carrier frequency randomly fluctuates from 3kHz to 5kHz.
- *When P00.17 = 4 or 8 kHz, the maximum setting for P00.34 is 2.0 kHz (± 1 kHz). The carrier frequency fluctuation range is according to the diagram below.*



- *When P00.17 = 5, 6, or 7 kHz, the maximum setting for P00.34 is 4.0 kHz (± 2 kHz). The carrier frequency fluctuation range is according to the diagram below.*



		Type	Hex Addr	Dec Addr
P00.35	***Auxiliary Frequency Source***	R/W	0023	40036
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Master and auxiliary frequency function disabled 1: Digital keypad 2: RS-485 communication input 3: Analog input 4: External UP / DOWN key input (multi-function input terminals) 7: Digital Keypad VR/Potentiometer Dial	0		

P00.35 determines the source for auxiliary frequency control.

		Type	Hex Addr	Dec Addr
P00.36	***Master and Auxiliary Frequency Command Selection***	R/W	0024	40037
	Range/Units (Format: 16-bit binary)	Default		
	0: Master + auxiliary frequency 1: Master - auxiliary frequency 2: Auxiliary - master frequency	0		

P00.36 sets the master frequency source according to P00.20, and sets the auxiliary frequency source according to P00.35. This parameter determines the addition and subtraction of the master and auxiliary frequency.

- *When P00.36 = 0, 1, 2, the control command comes after adding or subtracting the master / auxiliary frequency and the acceleration and deceleration (including S-curve).*
- *If the value is negative after adding or subtracting the master / auxiliary frequency, P03.10 determines whether to change the running direction.*
- *If you set the master frequency source (P00.20 = 0) or the auxiliary frequency source (P00.35 = 1) using the keypad, the F page of the keypad displays the setting frequency that you can use to set the master frequency or the auxiliary frequency. If the master frequency source or the auxiliary frequency source is NOT set by the keypad (P00.20 ≠ 0 and P00.35 ≠ 1), the F page of the keypad displays the value after adding or subtracting the master / auxiliary frequency.*
- *When setting the master frequency source and auxiliary frequency source, P00.35 cannot be set to the same value as P00.20 or P00.30*

		Type	Hex Addr	Dec Addr
P00.48	***Display Filter Time (Current)***	♦R/W	0030	40049
	Range/Units (Format: 16-bit unsigned)	Default		
	0.001–65.535 sec.	0.100		

P00.48 minimizes the current fluctuation displayed by the digital keypad.

		Type	Hex Addr	Dec Addr
P00.49	***Display Filter Time (User Display)***	♦R/W	0031	40050
	Range/Units (Format: 16-bit unsigned)	Default		
	0.001–65.535 sec.	0.100		

P00.49 minimizes the value fluctuation displayed by the digital keypad configurable user display. The filtering applies to P00.04 selections 0, 2, 4, 6, and 7 only. The default value of 0.100 disables the filtering.

		Type	Hex Addr	Dec Addr
P00.50	***Firmware Version (Date) Code***	Read	0032	40051
	Range/Units (Format: 16-bit unsigned)	Default		
	Read only	0		

P00.50 displays the current drive firmware version by date.

Group P01.xx Details – Basic Parameters

		Type	Hex Addr	Dec Addr
P01.00	**Maximum Operation Frequency of Motor 1**	R/W	0100	40257
P01.52	**Maximum Operation Frequency of Motor 2**	R/W	0134	40309
	Range/Units (Format: 16-bit unsigned)	Default		
	0.00–599.0 Hz	60.00 / 50.00		

These parameters determine the AC motor drive's maximum operation frequency. All the AC motor drive frequency command sources (analog inputs 0–10 V, 4–20 mA, 0–20 mA) are scaled to correspond to the output frequency range.

		Type	Hex Addr	Dec Addr
P01.01	**Output Frequency of Motor 1 (Base frequency / Motor's rated frequency)**	R/W	0101	40258
P01.35	**Output Frequency of Motor 2 (Base frequency / Motor's rated frequency)**	R/W	0123	40292
	Range/Units (Format: 16-bit unsigned)	Default		
	0.00–599.0 Hz	60.00 / 50.00		

Set these parameters according to the motor's rated frequency on the motor nameplate. If the motor's rated frequency is 60Hz, set this parameter to 60. If the motor's rated frequency is 50Hz, set this parameter to 50.

		Type	Hex Addr	Dec Addr
P01.02	**Output Voltage of Motor 1 (Base voltage / Motor's rated voltage)**	R/W	0102	40259
P01.36	**Output Voltage of Motor 2 (Base voltage / Motor's rated voltage)**	R/W	0124	40293
	Range/Units (Format: 16-bit unsigned)	Default		
	120V / 230V models: 0.0–255.0 V	220.0		
	460V models: 0.0–510.0 V	440.0		

Set these parameters according to the rated voltage on the motor nameplate. If the motor's rated voltage is 220V, set this parameter to 220.0. If the motor's rated voltage is 200V, set this parameter to 200.0.

		Type	Hex Addr	Dec Addr
P01.03	**Mid-point Frequency 1 of Motor 1**	R/W	0103	40260
P01.37	**Mid-point Frequency 1 of Motor 2**	R/W	0125	40294
	Range/Units (Format: 16-bit unsigned)	Default		
	0.00–599.0 Hz	3.00		

		Type	Hex Addr	Dec Addr
P01.04	**Mid-point Voltage 1 of Motor 1**	♦R/W	0104	40261
P01.38	**Mid-point Voltage 1 of Motor 2**	♦R/W	0126	40295
	Range/Units (Format: 16-bit unsigned)	Default		
	120V / 230V models: 0.0–240.0 V	11.0		
	460V models: 0.0–480.0 V	22.0		

		Type	Hex Addr	Dec Addr
P01.05	**Mid-point Frequency 2 of Motor 1**	R/W	0105	40262
P01.39	**Mid-point Frequency 2 of Motor 2**	R/W	0127	40296
	Range/Units (Format: 16-bit unsigned)	Default		
	0.00–599.0 Hz	1.50		

		Type	Hex Addr	Dec Addr
P01.06	***Mid-point Voltage 2 of Motor 1***	♦R/W	0106	40263
P01.40	***Mid-point Voltage 2 of Motor 2***	♦R/W	0128	40297

Range/Units (Format: 16-bit unsigned)	*Default*
120V / 230V models: 0.0–240.0 V	5.0
460V models: 0.0–480.0 V	10.0

		Type	Hex Addr	Dec Addr
P01.07	***Minimum Output Frequency of Motor 1***	R/W	0107	40264
P01.41	***Minimum Output Frequency of Motor 2***	R/W	0129	40298

Range/Units (Format: 16-bit unsigned)	*Default*
0.00–599.0 Hz	0.50

NOTE: P01.07 will set the V/F mode minimum frequency only. Use P01.11 to set the minimum frequency of the drive for any control mode.

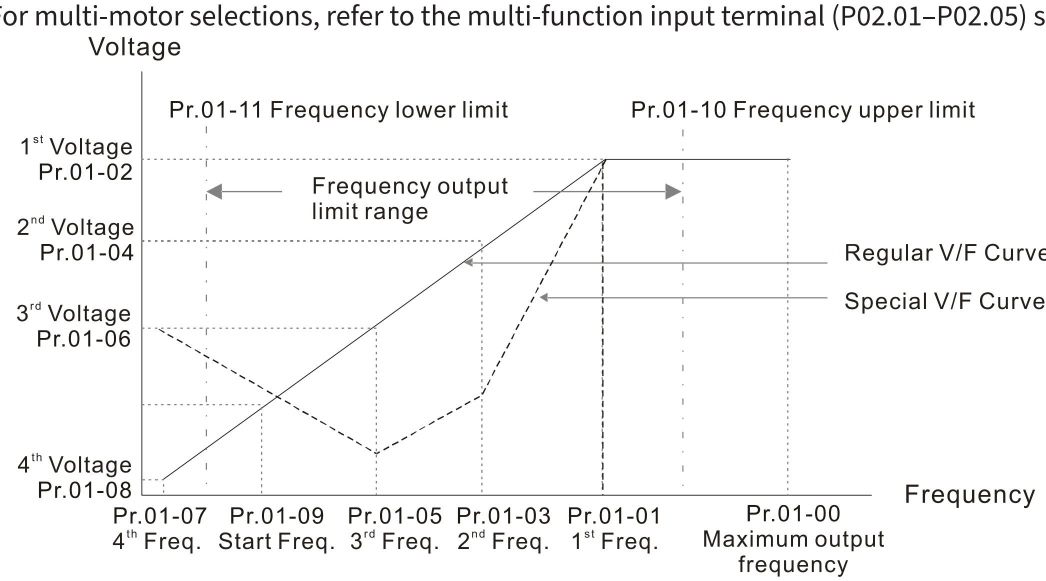
		Type	Hex Addr	Dec Addr
P01.08	***Minimum Output Voltage of Motor 1***	♦R/W	0108	40265
P01.42	***Minimum Output Voltage of Motor 2***	♦R/W	012A	40299

Range/Units (Format: 16-bit unsigned)	*Default*
120V / 230V models: 0.0–240.0 V	1.0
460V models: 0.0–480.0 V	2.0

You usually set the V/F curve according to the motor's allowable loading characteristics. Pay special attention to the motor's heat dissipation, dynamic balance, and bearing lubrication when the loading characteristics exceed the loading limit of the motor.

There is no limit for the voltage setting, but a high voltage at a low frequency may cause motor damage, overheating, and trigger the stall prevention or the over-current protection; therefore, use low voltage at low frequency to prevent motor damage or drive error.

The diagram below shows the V/F curve for motor 1. You can use the same V/F curve for motor 2. For multi-motor selections, refer to the multi-function input terminal (P02.01–P02.05) setting 83.

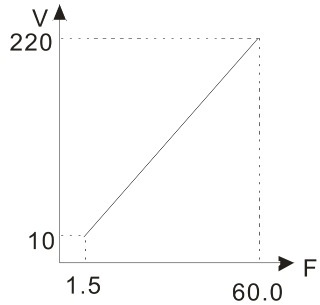


V/F Curve

Common settings for the V/F curve:

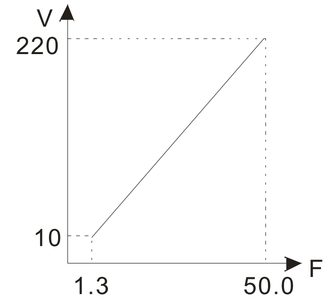
1) General purpose:

Motor spec. 60Hz



Pr.	Setting
01-00	60.0
01-01	60.0
01-02	220.0
01-03 01-05	1.50
01-04 01-06	10.0
01-07	1.50
01-08	10.0

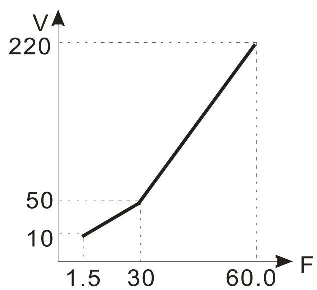
Motor spec. 50Hz



Pr.	Setting
01-00	50.0
01-01	50.0
01-02	220.0
01-03 01-05	1.30
01-04 01-06	10.0
01-07	1.30
01-08	10.0

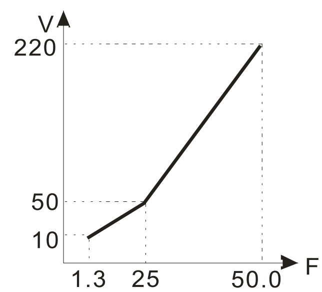
2) For fan and hydraulic machinery:

Motor spec. 60Hz



Pr.	Setting
01-00	60.0
01-01	60.0
01-02	220.0
01-03 01-05	30.0
01-04 01-06	50.0
01-07	1.50
01-08	10.0

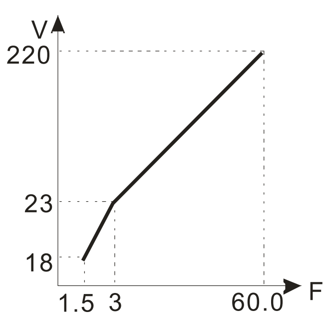
Motor spec. 50Hz



Pr.	Setting
01-00	50.0
01-01	50.0
01-02	220.0
01-03 01-05	25.0
01-04 01-06	50.0
01-07	1.30
01-08	10.0

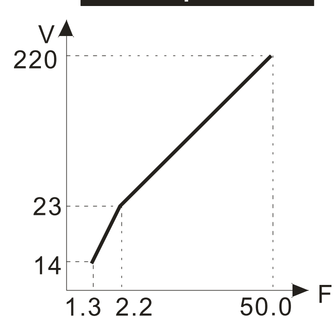
3) High starting torque:

Motor spec. 60Hz



Pr.	Setting
01-00	60.0
01-01	60.0
01-02	220.0
01-03 01-05	3.00
01-04 01-06	23.0
01-07	1.50
01-08	18.0

Motor spec. 50Hz

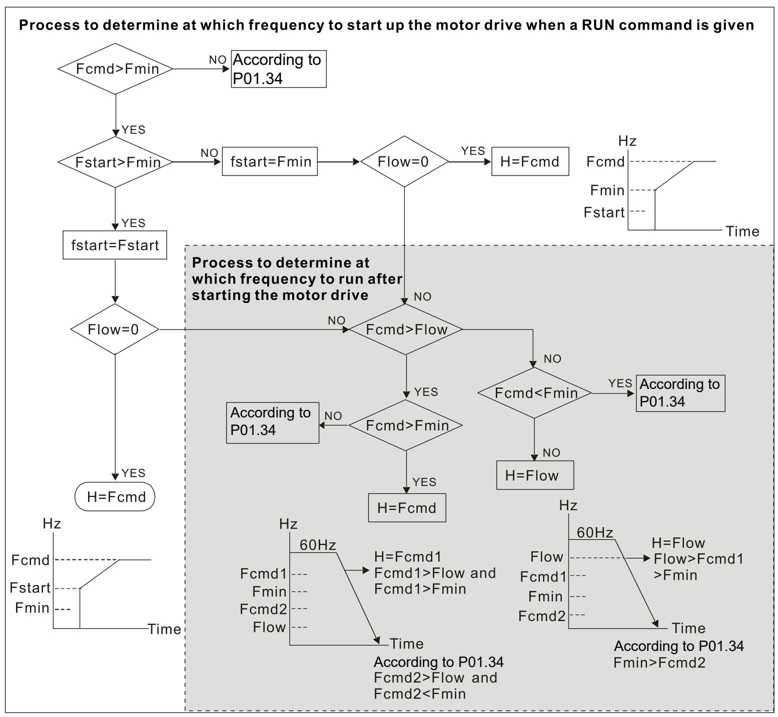


Pr.	Setting
01-00	50.0
01-01	50.0
01-02	220.0
01-03 01-05	2.20
01-04 01-06	23.0
01-07	1.30
01-08	14.0

		Type	Hex Addr	Dec Addr
P01.09	***Start-up Frequency***	R/W	0109	40266
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.0 Hz	0.50		

P01.09 is used to set the starting frequency of the drive.

- *When the starting frequency (P01.09) is larger than the minimum output frequency (P01.11), the drive's frequency output starts when the starting frequency (P01.09) reaches the F command. Refer to the diagram below for details.*
- *Fcmd = frequency command;*
  Fstart = start-up frequency (P01.09);
  fstart = actual start-up frequency of the drive;
  Fmin = 4th output frequency setting (P01.07 / P01.41);
  Flow = output frequency lower limit (P01.11)
- *When Fcmd > Fmin and Fcmd < Fstart:*
  If Flow < Fcmd, the drive runs directly with Fcmd.
  If Flow ≥ Fcmd, the drive runs with Fcmd, and then rises to Flow according to acceleration time.
- *The drive's output frequency goes directly to 0 when decelerating to Fmin.*

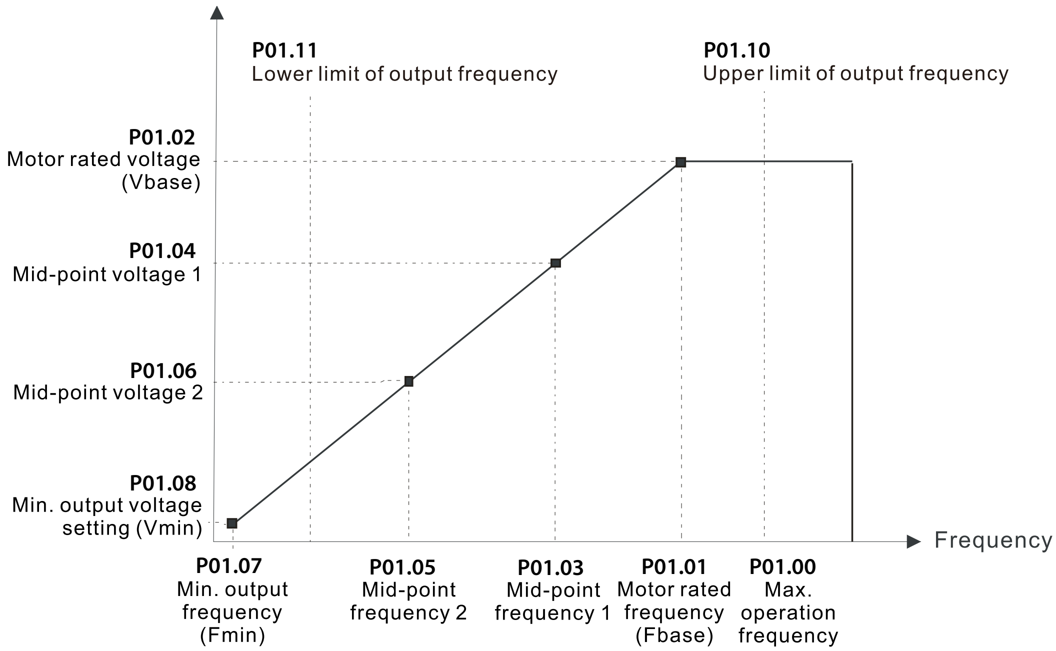


		Type	Hex Addr	Dec Addr
P01.10	***Output Frequency Upper Limit***	♦R/W	010A	40267
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.0 Hz	599.0		

		Type	Hex Addr	Dec Addr
P01.11	***Output Frequency Lower Limit***	♦R/W	010B	40268
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.0 Hz	0.00		

Use the upper and lower limit output frequency settings to limit the actual output frequency. If the output frequency setting is higher than the upper limit (P01.10), the drive runs with the upper limit frequency. If the output frequency setting is lower than the lower limit (P01.11) but higher than the minimum output frequency (P01.07), the drive runs with the lower limit frequency. Set the upper limit frequency > the lower limit frequency (P01.10 setting value must be > P01.11 setting value).

- *The upper output frequency limits the drive's maximum output frequency. If the frequency setting for the Frequency command is higher than P01.10, the drive runs with the P01.10 setting.*
- *If the PID feedback control is enabled for the drive, the drive's output frequency may exceed the Frequency command but is still limited by this setting.*
- *Related parameters: P01.00 Maximum Operation Frequency, P01.11 Output Frequency Lower Limit.*



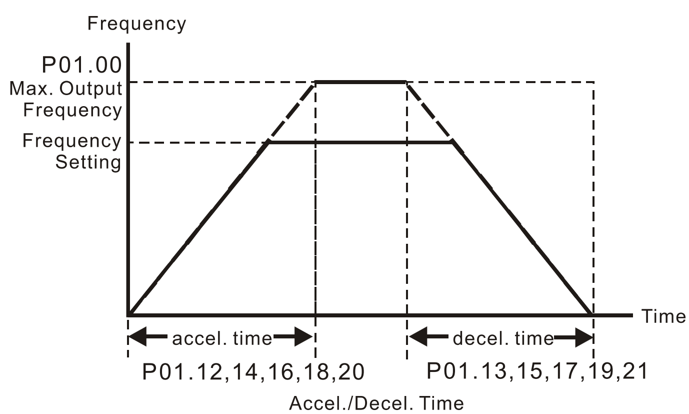
- *The lower output frequency limits the drive's minimum output frequency. If the frequency setting for the Frequency command is lower than P01.11, the drive runs with the P01.11 setting.*
- *When the drive starts, it operates according to the V/F curve and accelerates from the minimum output frequency (P01.07) to the setting frequency. It is not limited by the lower output frequency settings.*
- *Use the output frequency upper and lower limit settings to prevent operator misuse, overheating caused by the motor's operating at a too low frequency, or mechanical wear due to a too high speed.*
- *If the output frequency upper limit setting is 50Hz and the frequency setting is 60Hz, the maximum output frequency is 50Hz.*
- *If the output frequency lower limit setting is 10Hz and the minimum output frequency setting (P01.07) is 1.5 Hz, then the drive operates at 10Hz when the Frequency command is higher than P01.07 but lower than 10Hz. If the Frequency command is lower than P01.07, the drive is in ready status without output.*
- *If the frequency output upper limit is 60Hz and the frequency setting is also 60Hz, only the Frequency command is limited at 60Hz. The actual output frequency may be higher than 60Hz if used for slip compensation.*

		Type	Hex Addr	Dec Addr
P01.12	***Acceleration Time 1***	♦R/W	010C	40269
P01.13	***Deceleration Time 1***	♦R/W	010D	40270
P01.14	***Acceleration Time 2***	♦R/W	010E	40271
P01.15	***Deceleration Time 2***	♦R/W	010F	40272
P01.16	***Acceleration Time 3***	♦R/W	0110	40273
P01.17	***Deceleration Time 3***	♦R/W	0111	40274
P01.18	***Acceleration Time 4***	♦R/W	0112	40275
P01.19	***Deceleration Time 4***	♦R/W	0113	40276
P01.20	***JOG Acceleration Time***	♦R/W	0114	40277
P01.21	***JOG Deceleration Time***	♦R/W	0115	40278

Range/Units (Format: 16-bit unsigned)	Default
P01.45 = 0: 0.00–600.0 sec. P01.45 = 1: 0.0–6000 sec.	10.00 / 10.0

The acceleration time determines the time required for the AC motor drive to ramp from 0.00 Hz to the maximum operation frequency (P01.00). The deceleration time determines the time required for the AC motor drive to decelerate from the maximum operation frequency (P01.00) down to 0.00 Hz.

- *The acceleration and deceleration time are invalid when using P01.44 Auto-acceleration and Auto-deceleration Setting.*
- *Select the Acceleration/Deceleration Time 1, 2, 3, 4 with the multi-function input terminal settings. The defaults are Acceleration Time 1 and Deceleration Time 1.*
- *With the enabled torque limits and stall prevention functions, the actual acceleration and deceleration time are longer than the above action time.*
- *Note that setting the acceleration and deceleration time too short may trigger the drive's protection function (P06.03 Over-current Stall Prevention during Acceleration or P06.01 Over-voltage Stall Prevention), and the actual acceleration and deceleration time are longer than this setting.*
- *Note that setting the acceleration time too short may cause motor damage or trigger drive protection due to over-current during the drive's acceleration.*
- *Note that setting the deceleration time too short may cause motor damage or trigger drive protection due to over-current during the drive's deceleration or over-voltage.*
- *Use suitable braking resistors (refer to Appendix A: Accessories) to decelerate in a short time and prevent over-voltage.*
- *When you enable P01.24–P01.27 (S-curve acceleration and deceleration begin and arrival time), the actual acceleration and deceleration time are longer than the setting.*



		Type	Hex Addr	Dec Addr
P01.22	***JOG Frequency***	♦R/W	0116	40279
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.0 Hz	6.00		

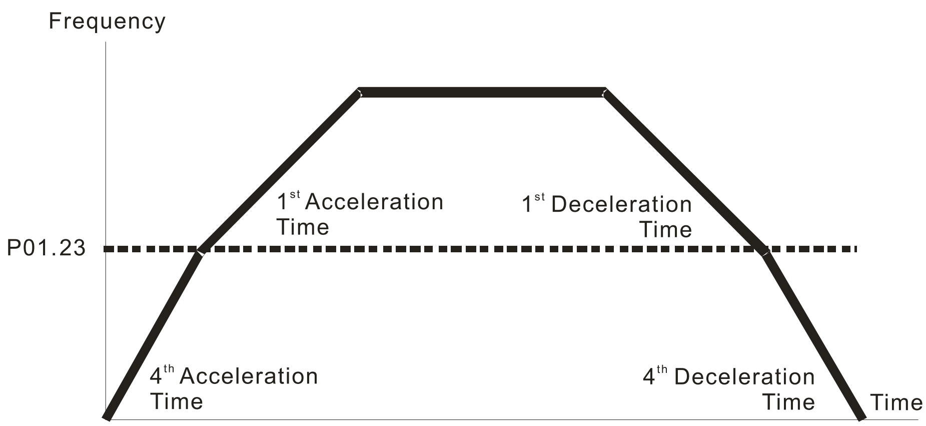
You can use both the external terminal JOG and F1 key on the optional keypad GS4-KPD (optional) to set the JOG function. When the JOG command is ON, the AC motor drive accelerates from 0 Hz to the JOG frequency (P01.22). When the JOG command is OFF, the AC motor drive decelerates from the JOG frequency to stop. The JOG acceleration and deceleration time (P01.20, P01.21) are the time to accelerate from 0.00 Hz to the JOG frequency (P01.22). You cannot execute the JOG command when the AC motor drive is running. When the JOG command is executing, other operation commands are invalid.

		Type	Hex Addr	Dec Addr
P01.23	***Switch Frequency between First and Fourth Accel./Decel.***	♦R/W	0117	40280
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.0 Hz	0.00		

This function does not require the external terminal switching function; it switches the acceleration and deceleration time automatically according to the P01.23 setting. If you set the external terminal, the external terminal has priority over P01.23.

When using this function, set the S-curve acceleration time to 0 if the fourth acceleration time is short.

1) If P01.12=10s, P 01.18=6s, then the acceleration time is 3s for 0–40 Hz and 5s for 40–80 Hz.
2) If P01.13=8s, P01.19=2s, then the deceleration time is 4s for 80–40 Hz and 1s for 40–0 Hz.

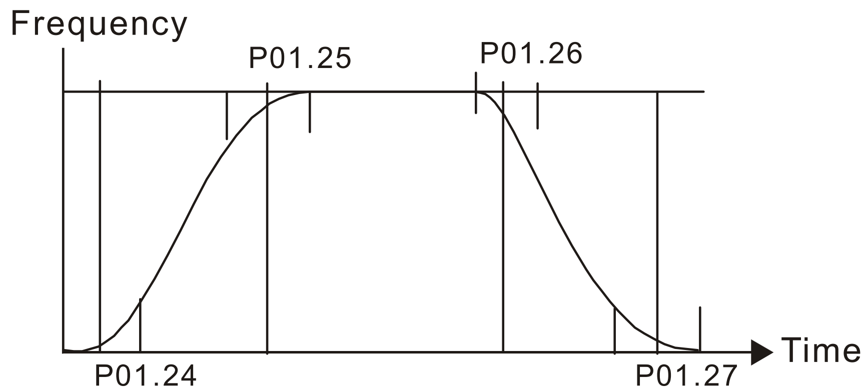


1st/4th Acceleration/Deceleration Frequency Switching

		Type	Hex Addr	Dec Addr
P01.24	***S-curve for Acceleration Begin Time 1***	♦R/W	0118	40281
P01.25	***S-curve for Acceleration Arrival Time 2***	♦R/W	0119	40282
P01.26	***S-curve for Deceleration Begin Time 1***	♦R/W	011A	40283
P01.27	***S-curve for Deceleration Arrival Time 2***	♦R/W	011B	40284
	Range/Units (Format: 16-bit unsigned)	*Default*		
	If P01.45 = 0: 0.00–25.00 sec.	0.20		
	If P01.45 = 1: 0.0–250.0 sec.	0.2		

These parameters allow you to enable an S-curve. Using an S-curve gives the smoothest transition between speed changes. The acceleration and deceleration curve adjusts the acceleration and deceleration S-curve. When enabled, the drive produces a different acceleration and deceleration curve according to the acceleration and deceleration time.

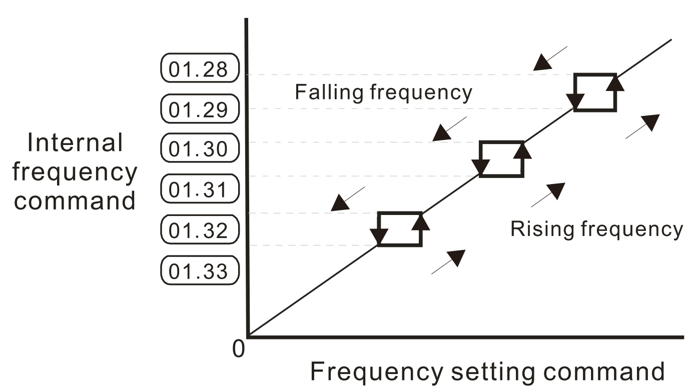
- *The S-curve function is invalid when you set the acceleration and deceleration time to 0.*
- *For P01.12, P01.14, P01.16, and P01.18:*
  When P01.1x ≥ P01.24 and P01.25, the actual acceleration time = P01.1x + (P01.24 + P01.25) / 2.
- *For P01.13, P01.15, P01.17, and P01.19:*
  When P01.1x ≥ P01.26 and P01.27, the actual deceleration time = P01.1x + (P01.26 + P01.27) / 2.



		Type	Hex Addr	Dec Addr
P01.28	***Skip Frequency 1 (Upper Limit)***	R/W	011C	40285
P01.29	***Skip Frequency 1 (Lower Limit)***	R/W	011D	40286
P01.30	***Skip Frequency 2 (Upper Limit)***	R/W	011E	40287
P01.31	***Skip Frequency 2 (Lower Limit)***	R/W	011F	40288
P01.32	***Skip Frequency 3 (Upper Limit)***	R/W	0120	40289
P01.33	***Skip Frequency 3 (Lower Limit)***	R/W	0121	40290
	Range/Units (Format: 16-bit unsigned)	Default		
	0.00–599.0 Hz	0.00		

These parameters set the AC motor drive's skip frequency. The drive's frequency setting skips these frequency ranges. However, the frequency output is continuous. There are no limits for these six parameters and you can combine them. P01.28 does not need to be greater than P01.29; P01.30 does not need to be greater than P01.31; P01.32 does not need to be greater than P01.33. You can set P01.28–01.33 as required. There is no size distinction among these six parameters.

- *These parameters set the skip frequency ranges for the AC motor drive. You can use this function to avoid frequencies that cause mechanical resonance. The skip frequencies are useful when a motor has resonance vibration at a specific frequency bandwidth. Skipping this frequency avoids the vibration. There are three frequency skip zones available.*
- *You can set the Frequency command (F) within the range of skip frequencies. Then the output frequency (H) is limited to the lower limit of skip frequency ranges.*
- *During acceleration and deceleration, the output frequency still passes through the skip frequency ranges.*

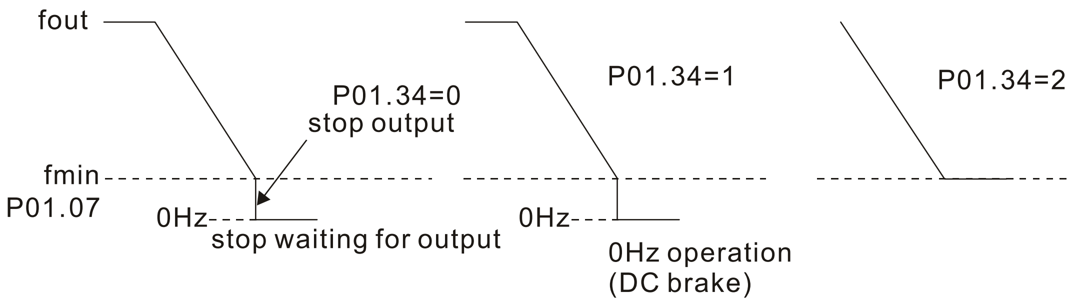


		Type	Hex Addr	Dec Addr
P01.34	***Zero-speed Mode***	R/W	0122	40291
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Output waiting 1: Zero-speed operation 2: Fmin (refer to P01.07 and P01.41)	0		

When the drive's Frequency command is lower than Fmin (P01.07 and P01.41), the drive operates according to this parameter.

- *0: the AC motor drive is in waiting mode without voltage output from terminals U, V, W.*
- *1: the drive executes the DC brake by Vmin (P01.08 and P01.42) in V/F, FOC sensorless, and SVC modes. And it executes zero-speed operation in VFPG mode.*
- *2: the AC motor drive runs using Fmin (P01.07 and P01.41) and Vmin (P01.08 and P01.42) in V/F and SVC modes.*

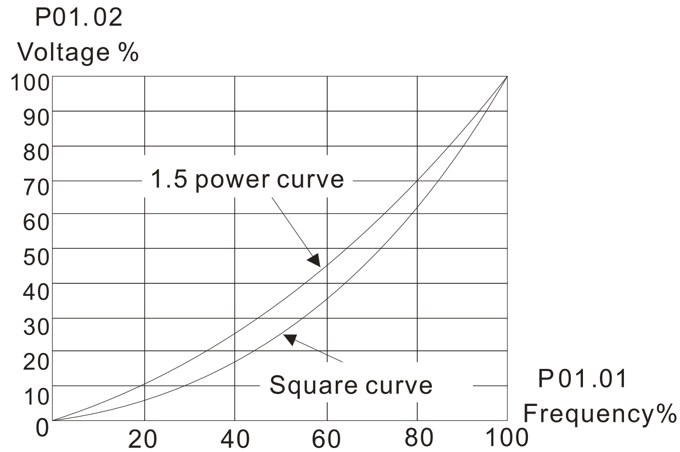
In V/F and SVC modes:



		Type	Hex Addr	Dec Addr
P01.43	***V/F Curve Selection***	R/W	012B	40300
	Range/Units (Format: 16-bit binary)	*Default*		
	0: V/F curve determined by P.01.00–P01.08 1: V/F curve to the power of 1.5 2: V/F curve to the power of 2	0		

P01.43 is used to select the desired V/F curve for your application.

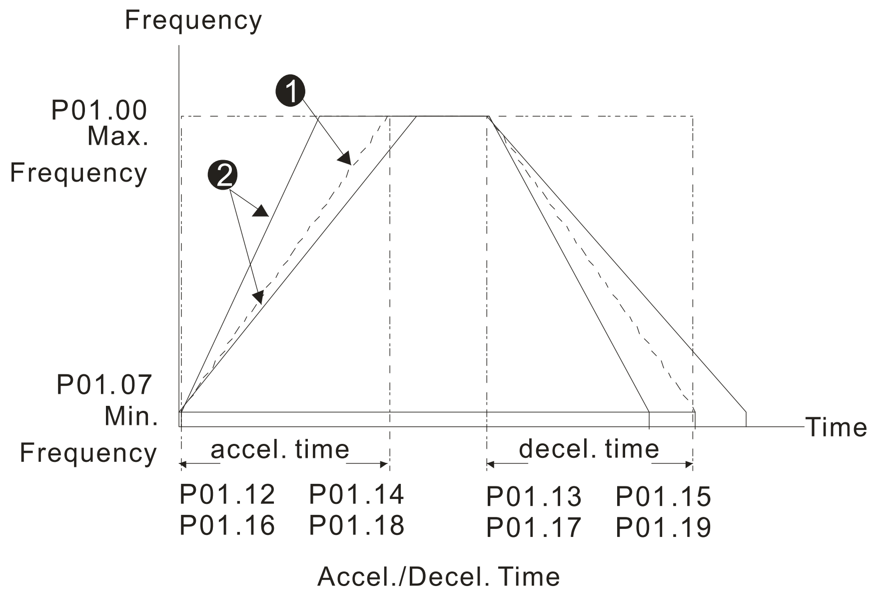
- *When setting to 0, refer to P01.01–01.08 for the motor 1 V/F curve. For motor 2, refer to P01.35–01.42. For motor 3, refer to P01.54–P01.61. For motor 4, refer to P01.35–P01.42.*
- *When setting to 1 or 2, the second and third voltage frequency settings (as shown in the V/F Curve diagram for P01.70) are invalid.*
- *If the load of the motor is a variable torque load (torque is in direct proportion to the rotating speed, such as the load of a fan or a pump), the load torque is low at low rotating speed. You can decrease the input voltage appropriately to make the magnetic field of the input current smaller and reduce flux loss and iron loss for the motor to increase efficiency.*
- *When you set the V/F curve to high power, it has lower torque at low frequency, and the drive is not suitable for rapid acceleration and deceleration. Do NOT use this parameter for rapid acceleration and deceleration.*



P01.44	***Auto-acceleration and Auto-deceleration Setting***	*Type*	*Hex Addr*	*Dec Addr*
		♦R/W	012C	40301
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Linear acceleration and deceleration 1: Auto-acceleration and linear deceleration 2: Linear acceleration and auto-deceleration 3: Auto-acceleration and auto-deceleration 4: Stall prevention by auto-acceleration and auto-deceleration (limited by P01.12 –P01.21)	0		

P01.44 is used to configure auto-acceleration and auto-deceleration settings.

- *0 (linear acceleration and deceleration): the drive accelerates and decelerates according to the setting for P01.12–P01.19.*
- *1 or 2 (auto/linear acceleration and auto/linear deceleration): the drive auto-tunes the acceleration and deceleration to effectively reduce the mechanical vibration during the load start-up and stop and make the auto-tuning process more easier. It does not stall during acceleration and does not need a braking resistor during deceleration to stop. It can also improve operation efficiency and save energy.*
- *3 (auto-acceleration and auto-deceleration–decelerating by the actual load): the drive auto-detects the load torque and automatically accelerates from the fastest acceleration time and smoothest start-up current to the setting frequency. During deceleration, the drive automatically determines the loaded regenerative energy to steadily and smoothly stop the motor in the fastest deceleration time.*
- *4 (stall prevention by auto-acceleration and deceleration–references the acceleration and deceleration time settings (P01.12 through P01.19). If the settings for acceleration and deceleration are too short, the actual acceleration and deceleration times will be greater than the acceleration and deceleration time settings.*



❶ When P01.44 is set to 0.

❷ When P01.44 is set to 3.

		Type	Hex Addr	Dec Addr
P01.45	***Time Unit for Acceleration and Deceleration and S-Curve***	R/W	012D	40302
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Unit 0.01 sec. 1: Unit 0.1 sec.	0		

		Type	Hex Addr	Dec Addr
P01.49	***Regenerative Energy Restriction Control Method***	R/W	0131	40306
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable 1: Over voltage energy restriction 2: Traction energy control (TEC)	0		

P01.49 is used to select the regenerative energy restriction control method.

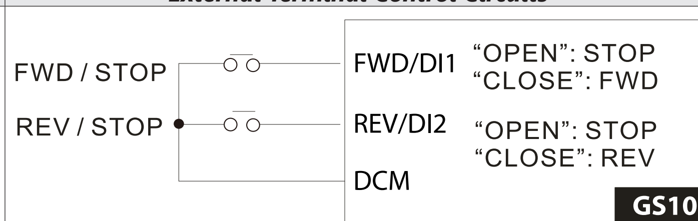
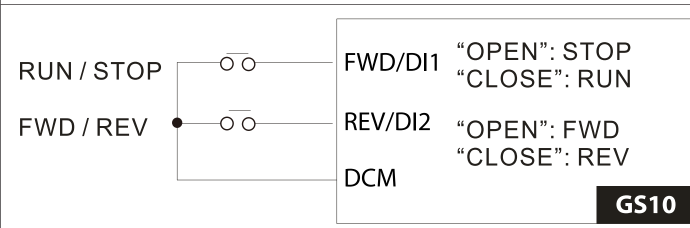
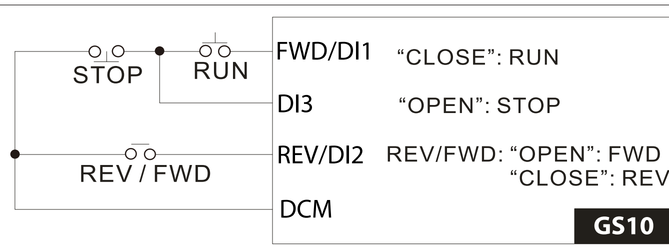
- *0: decelerate or stop in accordance with the original deceleration setting. The actual deceleration time of the motor is longer than the deceleration time setting because of the over-voltage stall prevention.*
- *1: during deceleration, the drive controls the motor according to the setting for P06.01 and the recovery voltage of the DC bus. The controller starts when the DC bus voltage reaches 95% of P06.01. When P06.01 is set to 0, the drive controls the motor according to the operating voltage and the recovery voltage of the DC bus. This method decelerates according to the setting for the deceleration time. The fastest actual deceleration time is not less than the deceleration time setting.*
- *2: during deceleration, the drive controls the motor according to the setting for P06.01 and the DC bus voltage. The controller starts when the DC bus voltage reaches 95% of P06.01, auto-tunes the output frequency and the output voltage to increase the consumption of the regenerative energy according to the drive's capability, and the deceleration time is the result of the drive's auto-tuning. Use this setting when over-voltage occurs due to unexpected deceleration time.*

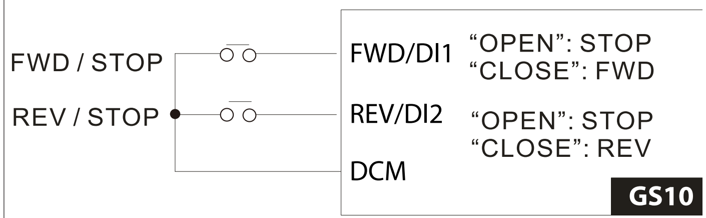
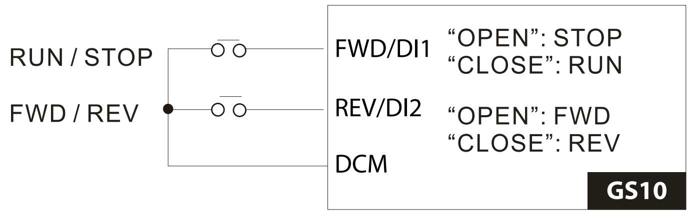
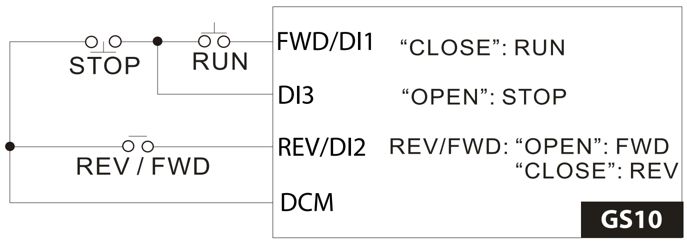
Group P02.xx Details – Digital Input/Output Parameters

		Type	Hex Addr	Dec Addr
P02.00	**Two-wire / Three-wire Operation Control**	R/W	0200	40513
	Range/Units (Format: 16-bit binary)	*Default*		
	0: No function	1		
	1: Two-wire mode 1, power on for operation control (DI1: FWD / STOP, DI2: REV / STOP)			
	2: Two-wire mode 2, power on for operation control (DI1: RUN / STOP, DI2: REV / FWD)			
	3: Three-wire, power on for operation control (DI1: RUN, DI2: REV / FWD, DI3: STOP)			
	4: Two-wire mode 1, Quick Start (DI1: FWD / STOP, DI2: REV / STOP)			
	5: Two-wire mode 2, Quick Start (DI1: RUN / STOP, DI2: REV / FWD)			
	6: Three-wire, Quick Start (DI1: RUN, DI2: REV / FWD, DI3: STOP)			

P02.00 is used to set the 2-wire or 3-wire operation control mode.

- *In the Quick Start function, the output remains ready for operation. The drive responds to the Start command immediately.*
- *When using Quick Start function, the output terminals UVW are with driving voltages in order to output and respond immediately if a Start command is given. Do NOT touch the terminals or modify the motor wiring to prevent electric shocks.*
- *This parameter sets the configuration of the external drive operation control and the Quick Start function. There are six different control modes listed in the following table.*

P02.00	External Terminal Control Circuits
Setting value: 1 Two-wire operation control FWD / STOP REV / STOP	
Setting value: 2 Two-wire operation control RUN / STOP FWD / REV	
Setting value: 3 Three-wire operation control	

<table>
<tr><th>P02.00</th><th>External Terminal Control Circuits</th></tr>
<tr><td>Setting value: 4
Two-wire operation control
Quick Start</td><td>
</td></tr>
<tr><td>Setting value: 5
Two-wire operation control
Quick Start</td><td>
</td></tr>
<tr><td>Setting value: 6
Three-wire operation control
Quick Start</td><td>
</td></tr>
</table>

		Type	Hex Addr	Dec Addr	Default
P02.01	***Multi-function input Command 1 (FWD/DI1)***	R/W	0201	40514	0
P02.02	***Multi-function input Command 2 (REV/DI2)***	R/W	0202	40515	0
P02.03	***Multi-function input Command 3 (DI3)***	R/W	0203	40516	1
P02.04	***Multi-function input Command 4 (DI4)***	R/W	0204	40517	2
P02.05	***Multi-function input Command 5 (DI5)***	R/W	0205	40518	3

Range/Units (Format: 16-bit binary)

0: No function
1: Multi-step speed command 1
2: Multi-step speed command 2
3: Multi-step speed command 3
4: Multi-step speed command 4
5: Reset
6: JOG [by external control or GS4-KPD (optional)]
7: Acceleration / deceleration speed inhibit
8: 1st and 2nd acceleration / deceleration time selection
9: 3rd and 4th acceleration / deceleration time selection
10: External Fault (EF) Input (P07.20)
11: Base Block (B.B.) input from external source
12: Output stop
13: Cancel the setting of auto-acceleration / auto-deceleration time
15: Rotating speed command from AI
18: Force to stop (P07.20)
19: Digital up command
20: Digital down command
21: PID function disabled
22: Clear the counter
23: Input the counter value (DI4)
24: FWD JOG command
25: REV JOG command
28: Emergency stop (EF1)
29: Signal confirmation for Y-connection
30: Signal confirmation for Δ-connection
38: Disable writing EEPROM function
40: Force coasting to stop
41: HAND switch
42: AUTO switch
49: Enable drive
50: Slave dEb action to execute
56: Local / Remote selection
58: Enable fire mode (with RUN command)
59: Enable fire mode (without RUN command)
69: Auto-activate preheating command
70: Force auxiliary frequency return to 0
71: Disable PID function, force PID output return to 0
72: Disable PID function, retain the output value before disabled
73: Force PID integral gain return to 0, disable integral
74: Reverse PID feedback
83: Multi-motor (IM) selection bit 0
94: Programmable AUTO RUN
95: Pausing AUTO RUN
97: Multi-pumps switch by Hand / Auto mode
98: Simple positioning stop by forward limit
99: Simple positioning stop by reverse limit

These parameters select the functions for each digital terminal.

- *When P02.00 = 0, you can set digital options with multi-function input terminals DI1, DI2.*
- *When P02.00 ≠ 0, the multi-function input terminals DI1, DI2 work in accordance with the setting values for P02.00.*

Example:

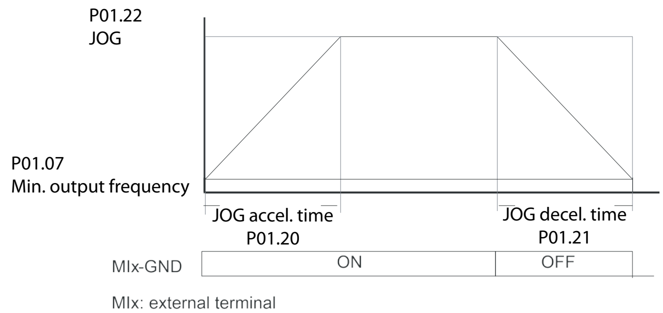
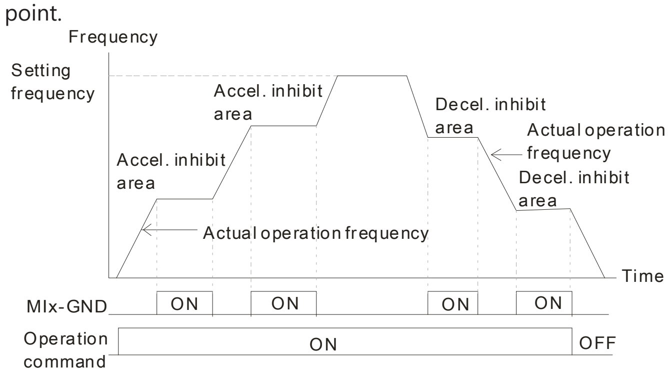
- *If P02.00 = 1: multi-function input terminal DI1 = FWD / STOP, DI2 = REV / STOP.*
- *If P02.00 = 2: multi-function input terminal DI1 = RUN / STOP, DI2 = FWD / REV.*
- *When multi-function input terminal DI5 = 0, DI5 is designated as a pulse input terminal.*

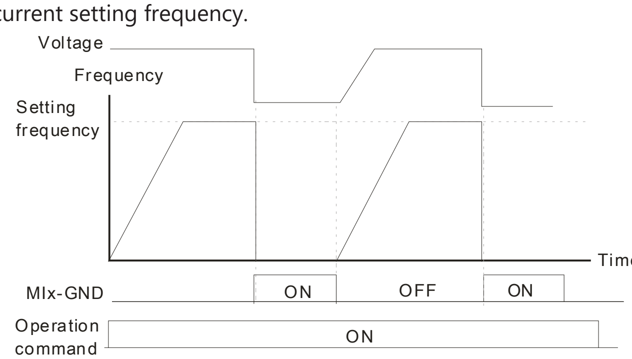
- *If P02.00 is set to three-wire operation control, terminal DI3 is for the STOP contact. The function set previously for this terminal is automatically invalid.*

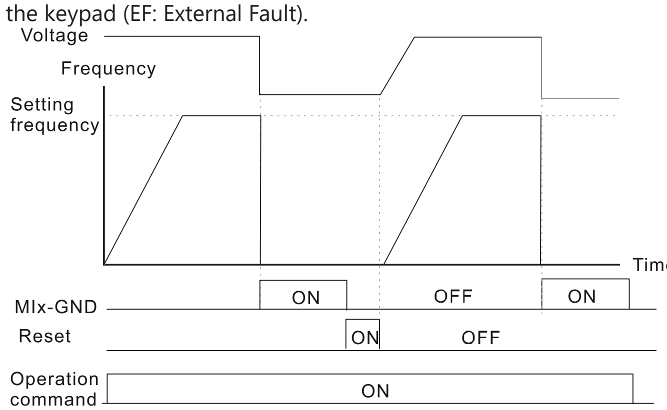
DI5 for Pulse Feedback:

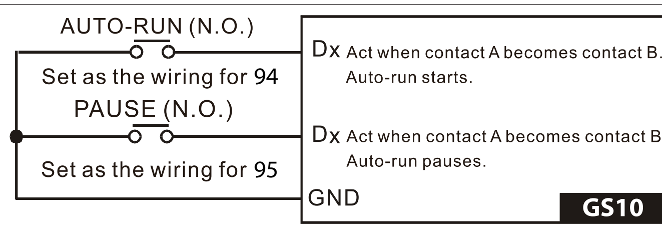
DI5 is set to "0" for pulse feedback. See Group 10 Parameter details for more information.

Summary of Function Settings

Setting	Function	Description
0	No function	
1	Multi-step speed command 1	You can set 15 steps of speed with the digital status of these four terminals. You can use 16-steps of speed if you include the master speed when setting as 15 steps of speed (refer to Parameter Group 04 Multi-step Speed Parameters).
2	Multi-step speed command 2	
3	Multi-step speed command 3	
4	Multi-step speed command 4	
5	Reset	Use this terminal to reset the drive after clearing a drive fault.
6	JOG operation [by external control or GS4-KPD (optional)]	This function is valid when the source of the operation command is the external terminals. The JOG operation executes when the drive stops completely. While running, you can still change the operation direction, and the STOP key on the keypad* and the STOP command from communications are valid. Once the external terminal receives the OFF command, the motor stops in the JOG deceleration time. Refer to P01.20–P01.22 for details. *: This function is valid when P00.32 is set to 1. 
7	Acceleration / deceleration speed inhibit	When you enable this function, the drive stops acceleration or deceleration immediately. After you disable this function, the AC motor drive starts to accelerate or decelerate from the inhibit point. 

<table>
<tr><th>Setting</th><th>Function</th><th>Description</th></tr>
<tr><td>8</td><td>1st and 2nd acceleration / deceleration time selection</td><td rowspan="2">You can select the acceleration and deceleration time of the drive with this function, or from the digital status of the terminals; there are four acceleration and deceleration selections.
<table>
<tr><th rowspan="2">DI1 Option 8 (bit 0)</th><th rowspan="2">BI2 Option 9 (bit 1)</th><th rowspan="2">Acc/Dec Selection</th><th colspan="2">Related Parameters</th></tr>
<tr><th>Accel</th><th>Decel</th></tr>
<tr><td>0</td><td>0</td><td>Acc/Dec 1</td><td>01.12</td><td>01.13</td></tr>
<tr><td>1</td><td>0</td><td>Acc/Dec 2</td><td>01.14</td><td>01.15</td></tr>
<tr><td>0</td><td>1</td><td>Acc/Dec 3</td><td>01.16</td><td>01.17</td></tr>
<tr><td>1</td><td>1</td><td>Acc/Dec 4</td><td>01.18</td><td>01.19</td></tr>
</table></td></tr>
<tr><td>9</td><td>3rd and 4th acceleration / deceleration time selection</td></tr>
<tr><td>10</td><td>External Fault (EF) input (P07.20)</td><td>For external fault input. The drive decelerates according to the P07.20 setting, and the keypad shows “EF” (it shows the fault record when an external fault occurs). The drive will begin running again when the fault is cleared (terminal status restored) and RESET is pressed.</td></tr>
<tr><td>11</td><td>Base Block (B.B.) input from external</td><td>ON: the output of the drive stops immediately. The motor is in free run and the keypad displays the B.B. signal. Refer to P07.08 for details.</td></tr>
<tr><td>12</td><td>Output stop</td><td>ON: the output of the drive stops immediately, and the motor is in free run status. The drive is in output waiting status until the switch is turned to OFF, and then the drive restarts and runs to the current setting frequency.

</td></tr>
<tr><td>13</td><td>Cancel the setting of auto-acceleration / auto-deceleration time</td><td>Set P01.44 to one of the 01–04 setting modes before using this function. When this function is enabled, OFF is for auto mode and ON is for linear acceleration / deceleration.</td></tr>
<tr><td>15</td><td>Rotating speed command from AI</td><td>ON: force the source of the drive’s frequency to be AI. (AI-V or AI-C)</td></tr>
<tr><td>18</td><td>Force to stop (P07.20)</td><td>ON: the drive ramps to a stop according to the P07.20 setting.</td></tr>
<tr><td>19</td><td>Digital up command</td><td rowspan="2">ON: the frequency of the drive increases or decreases by one unit. If this function remains ON continuously, the frequency increases or decreases according to P02.09 / P02.10.
The Frequency command returns to zero when the drive stops and the displayed frequency is 0.00 Hz. If you select P11.00, bit 7 = 1, the frequency is not saved.</td></tr>
<tr><td>20</td><td>Digital down command</td></tr>
<tr><td>21</td><td>PID function disabled</td><td>ON: the PID function is disabled.</td></tr>
<tr><td>22</td><td>Clear the counter</td><td>ON: the current counter value is cleared and displays 0. The drive counts up when this function is disabled.</td></tr>
<tr><td>23</td><td>Input the counter value (DI4)</td><td>ON: the counter value increases by one. Use the function with P02.19.</td></tr>
<tr><td>24</td><td>FWD JOG command</td><td>This function is valid when the source of the operation command is the external terminal. ON: the drive executes forward JOG. When executing the JOG command in torque mode, the drive automatically switches to speed mode. The drive returns to torque mode after the JOG command is complete.</td></tr>
</table>

<table>
<tr><th>Setting</th><th>Function</th><th>Description</th></tr>
<tr><td>25</td><td>REV JOG command</td><td>This function is valid when the source of the operation command is the external terminal. ON: the drive executes reverse JOG. When executing the JOG command in torque mode, the drive automatically switches to speed mode. The drive returns to torque mode after the JOG command is complete.</td></tr>
<tr><td>28</td><td>Emergency stop (EF1)</td><td>ON: the output of the drive stops immediately, displays “EF1” on the keypad, and the motor is in free run status. The drive remains stopped until the external fault is cleared after you press RESET on the keypad (EF: External Fault).

</td></tr>
<tr><td>29</td><td>Signal confirmation for Y-connection</td><td>When the control mode is V/F, ON: the drive operates by the first V/F.</td></tr>
<tr><td>30</td><td>Signal confirmation for Δ-connection</td><td>When the control mode is V/F, ON: the drive operates by the second V/F.</td></tr>
<tr><td>38</td><td>Disable writing EEPROM function (parameters memory disable)</td><td>ON: writing to EEPROM is disabled. Changed parameters are not saved after power off.</td></tr>
<tr><td>40</td><td>Force coasting to stop</td><td>ON: during operation, the motor coasts to stop.</td></tr>
<tr><td>41</td><td>HAND switch</td><td rowspan="2">1) When the DI terminal switches to OFF, it executes a STOP command. Therefore, if the DI terminal switches to OFF during operation, the drive stops.
2) Use the optional keypad GS4-KPD to switch between HAND and AUTO. The drive stops first, and then switches to HAND or AUTO status.
3) The optional digital keypad GS4-KPD displays the current status of the drive (HAND / OFF / AUTO).
<table><tr><th></th><th>bit 1</th><th>bit 0</th></tr><tr><td>OFF</td><td>0</td><td>0</td></tr><tr><td>AUTO</td><td>0</td><td>1</td></tr><tr><td>HAND</td><td>1</td><td>0</td></tr><tr><td>OFF</td><td>1</td><td>1</td></tr></table></td></tr>
<tr><td>42</td><td>AUTO switch</td></tr>
<tr><td>49</td><td>Enable drive</td><td>When the drive is enabled, the RUN command is valid.
When the drive is disabled, the RUN command is invalid.
When the drive is operating, the motor coasts to stop.
This function varies with a Multifunction Output DO1 = 45.</td></tr>
<tr><td>50</td><td>Slave dEb action to execute</td><td>Enter the message setting in this parameter when the master triggers dEb. This ensures that the slave also triggers dEb, then the master and slave stop simultaneously.</td></tr>
<tr><td>56</td><td>Local / Remote selection</td><td>Use P00.29 to select LOCAL / REMOTE mode. When P00.29 is not set to 0, the optional digital keypad GS4-KPD displays LOC / REM status. (Refer to P00.29 for details).
<table><tr><th></th><th>bit 0</th></tr><tr><td>REM</td><td>0</td></tr><tr><td>LOC</td><td>1</td></tr></table></td></tr>
</table>

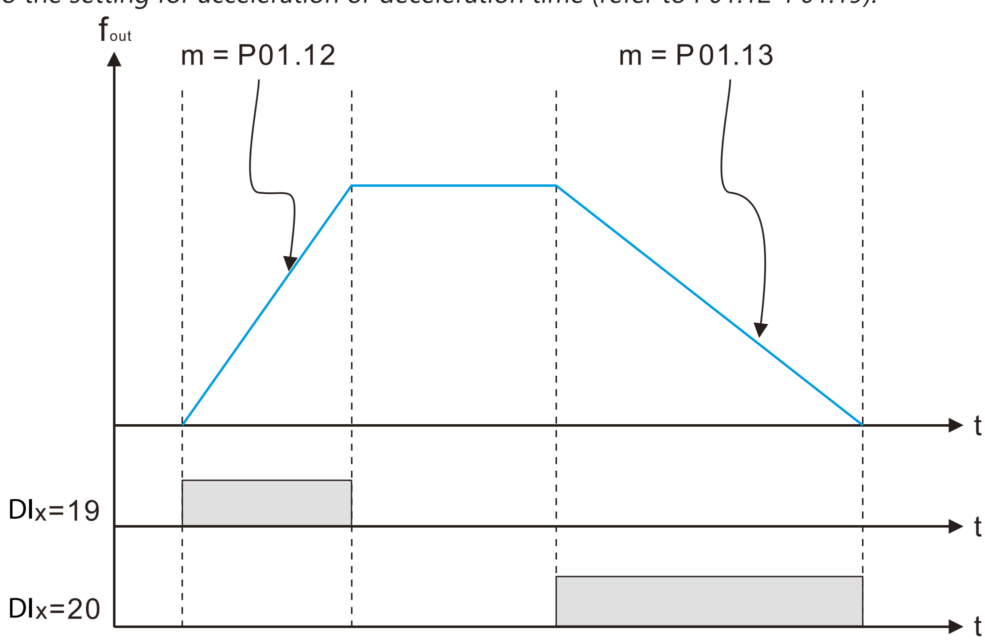
<table>
<tr><th>Setting</th><th>Function</th><th>Description</th></tr>
<tr><td>58</td><td>Enable fire mode
(with RUN command)</td><td>When fire occurs, enable this terminal to make the drive enter the fire mode to force the drive to run. If the drive is in stop status, enable this terminal to make the drive enter the fire mode to force the drive to run according to P06.80 settings. (Refer to P06.80, P06.81, P06.88 for details).</td></tr>
<tr><td>59</td><td>Enable fire mode (without RUN command)</td><td>When fire occurs, enable this terminal to make the drive enter the fire mode.
If the drive is in stop status, enable this terminal to make the drive enter the fire mode, but the drive does not run.
If the drive is in running status, enable this terminal to run the drive according to P06.80 settings. (Refer to P06.80, P06.81, P06.88 for details)</td></tr>
<tr><td>69</td><td>Auto-activate preheating function</td><td>When you set DIx = 69 (auto-activate preheating function), the enabling and disabling for preheating function is determined by DIx.</td></tr>
<tr><td>70</td><td>Force auxiliary frequency return to 0</td><td>Forces the auxiliary frequency return to 0 when using this function. PID keeps operating if PID is the master frequency. When P00.35 ≠ 0, the master and auxiliary frequencies are enabled, and then selecting this function with the terminal effectively forces the auxiliary frequency return to 0.</td></tr>
<tr><td>71</td><td>Disable PID function, force PID output return to 0</td><td>When the master and auxiliary frequencies are enabled and when using the PID function, ON: PID does not operate, returns the integral value to 0, and forces the PID output return to 0.</td></tr>
<tr><td>72</td><td>Disable PID function, retain the output value before disabled</td><td>When the master and auxiliary frequencies are enabled, and the PID function is enabled, ON: PID does not operate, and its output value remains the same as the value before it was disabled.</td></tr>
<tr><td>83</td><td>Multi-motor (IM) selection bit 0</td><td>ON: parameters can be changed.
Example: DI1 = 83
<table>
<tr><th rowspan="2">DI1</th><th rowspan="2">Motor Selection</th><th colspan="2">Related Motor Parameter</th></tr>
<tr><td>Max Operation Frequency</td><td>V/F Curve Parameters</td></tr>
<tr><td>OFF</td><td>Motor 1</td><td>P01.00</td><td>P01.01–P01.08</td></tr>
<tr><td>ON</td><td>Motor 2</td><td>P01.52</td><td>P01.35–P01.42</td></tr>
</table></td></tr>
<tr><td>94</td><td>Programmable AUTO RUN</td><td>
</td></tr>
<tr><td>95</td><td>Pausing AUTO RUN</td><td>When the functional terminals for programmable auto-run enable, the output frequency of the AC motor drive operates automatically according to the settings for multi-step speed.
You can pause the terminals to temporarily stop the running program during operation. The program resumes running after the pausing finishes.</td></tr>
<tr><td>97</td><td>Multi-pumps switch by Hand / Auto mode</td><td>Use this terminal to switch between Hand / Auto mode.</td></tr>
<tr><td>98</td><td>Simple positioning stop by forward limit</td><td>If the motor receives this signal while running forward, it stops running forward.</td></tr>
<tr><td>99</td><td>Simple positioning stop by reverse limit</td><td>If the motor receives this signal while running reverse, it stops running reverse.</td></tr>
</table>

		Type	Hex Addr	Dec Addr
P02.09	***UP / DOWN Key Mode***	♦R/W	0209	40522
	Range/Units (Format: 16-bit binary)	*Default*		
	0: UP / DOWN by the acceleration / deceleration time 1: UP / DOWN constant speed (P02.10) 2: Pulse signal (P02.10) 3: Curve	0		

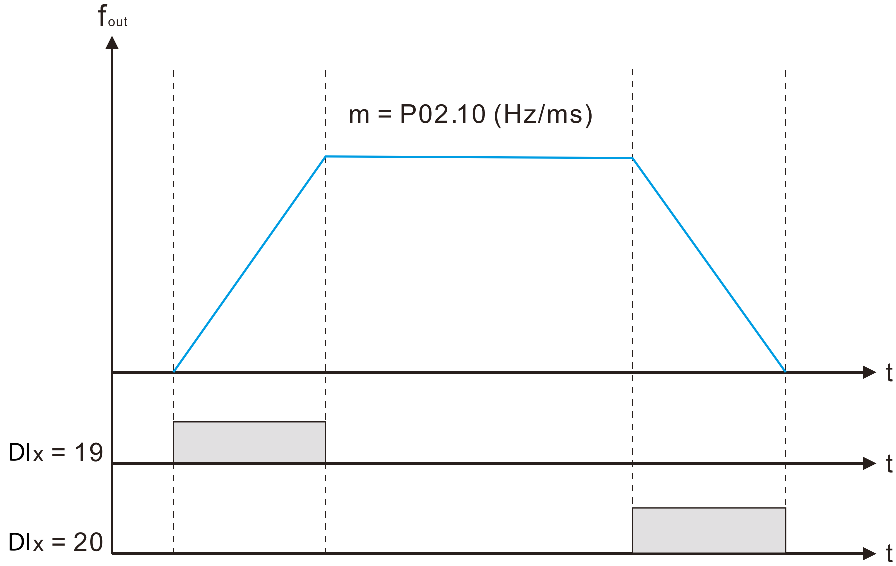
		Type	Hex Addr	Dec Addr
P02.10	***Constant Speed, Acceleration / Deceleration Speed of the UP / DOWN Key***	♦R/W	020A	40523
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.001–1.000 Hz / ms	0.001		

These parameters are used when the multi-function input terminals are set to 19, 20 (Digital UP / DOWN command). The frequency increases or decreases according to P02.09 and P02.10.

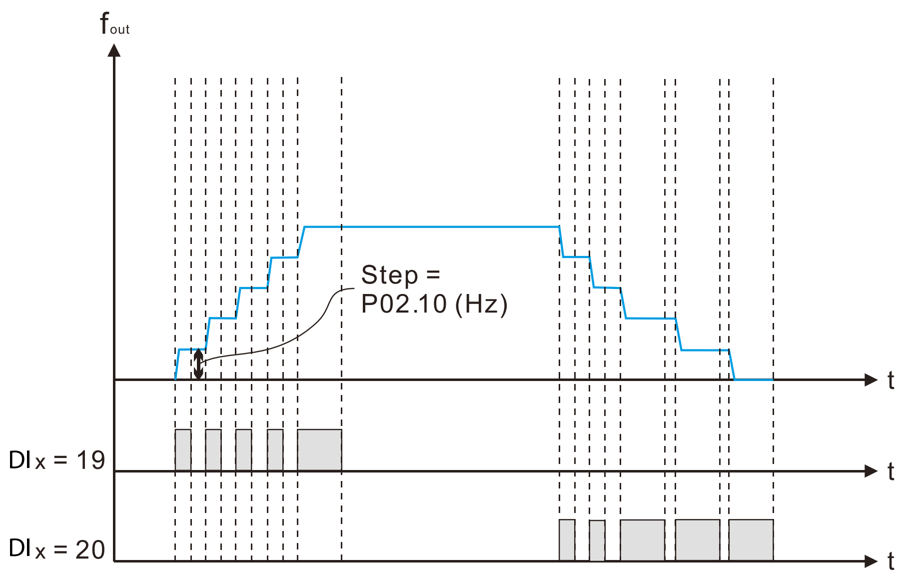
- *When P11.00 bit 7 = 1, the frequency is not saved. The Frequency command returns to zero when the drive stops, and the displayed frequency is 0.00 Hz. At this time, increasing or decreasing the Frequency command (F) by using the UP or DOWN key is valid only when the drive is running.*
- *When P02.09 is set to 0, the increasing or decreasing Frequency command (F) operates according to the setting for acceleration or deceleration time (refer to P01.12–P01.19).*



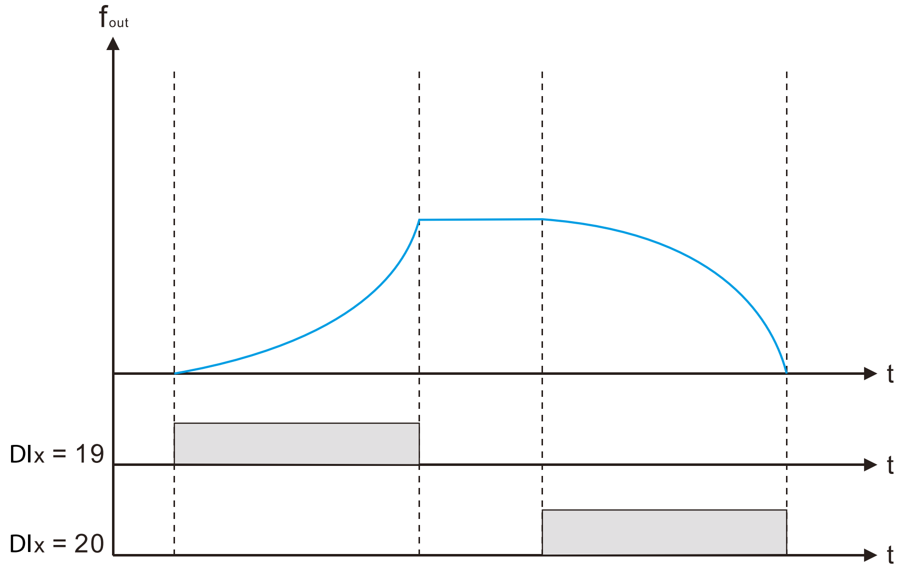
- *When P02.09 is set to 1, the increasing or decreasing Frequency command (F) operates according to the setting of P02.10 (0.001–1.000 Hz/ms).*



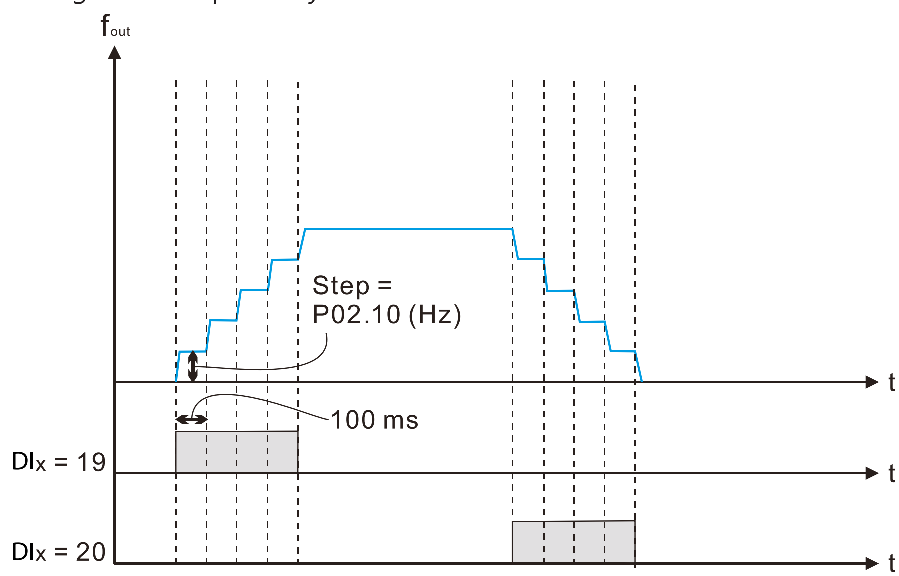
- *When P02.09 is set to 2, the increasing/decreasing frequency command (F) operates according to the pulse of P02.10.*



- *When P02.09 is set to 3, the increasing/decreasing frequency command (F) operates according to the exponential curve.*



- *When P02.09 is set to 4, the increasing/decreasing frequency command (F) operates according to the setting of P02.10 per every 100ms.*



		Type	Hex Addr	Dec Addr
P02.11	***Multi-function Input Response Time***	♦R/W	020B	40524
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.000–30.000 sec.	0.005		

Use P02.11 to set the response time of the digital input terminals DI1–DI5.

This function is to delay and confirm the digital input terminal signal. The time for delay is also the time for confirmation. The confirmation prevents interference that could cause error in the input to the digital terminals. It delays the response time though confirmation to improve accuracy.

		Type	Hex Addr	Dec Addr
P02.12	***Multi-function Input Mode Selection***	♦R/W	020C	40525
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0000h–FFFFh (0: N.O.; 1: N.C.)	0000		

The parameter value will be displayed/entered in decimal format on the drive keypad or in GSoft2. If using the GS4-KPD, the value will be displayed/entered in hexadecimal format. This parameter sets the status of the multi-function input signal (0: normally open, 1: normally closed) and it is not affected by the status of SINK / SOURCE.

- *bit 0–bit 4 correspond to DI1–DI5.*
- *The default for bit 0 (DI1) is FWD terminal, and the default for bit 1 (DI2) is REV terminal. You cannot use this parameter to change the input mode when P02.00 ≠ 0.*
- *You can change the terminal ON / OFF status through communications.*
- *For example: DI3 is set to 1 (multi-step speed command 1) and DI4 is set to 2 (multi-step speed command 2). Then the forward + second step speed command = 1001 (binary) = 9 (decimal).*
- *As long as P02.12 = 9 is set through communications, there is no need to wire any multi-function terminal to run forward with the second step speed.*

bit 4	***bit 3***	***bit 2***	***bit 1***	***bit 0***
DI5	DI4	DI3	DI2	DI1

- *Use P11.42 bit 1 to select whether FWD / REV terminal is controlled by P02.12 bit 0 and bit 1.*

		Type	Hex Addr	Dec Addr	Default
P02.13	***Multi-function Output 1 (R1)***	♦R/W	020D	40526	11
P02.16	***Multi-function Output 2 (DO1)***	♦R/W	0210	40529	0

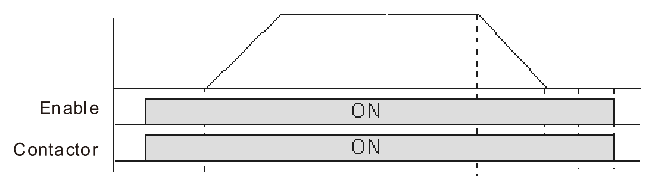
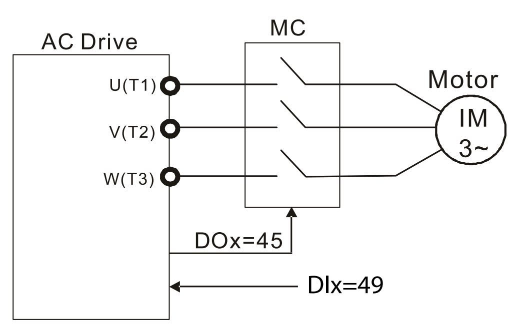
Range/Units (Format: 16-bit binary)

0: No function
1: Indication during RUN
2: Operation speed reached
3: Desired frequency reached 1 (P02.22)
4: Desired frequency reached 2 (P02.24)
5: Zero speed (Frequency command)
6: Zero speed including STOP (Frequency command)
7: Over-torque 1 (P06.06–06.08)
8: Over-torque 2 (P06.09–06.11)
9: Drive is ready
10: Low voltage warning (Lv) (P06.00)
11: Malfunction indication
13: Overheat warning (P06.15)
14: Software brake signal indicator (P07.00)
15: PID feedback error (P08.13, P08.14)
16: Slip error (oSL)
17: Count value reached, does not return to 0 (P02.20)
18: Count value reached, return to 0 (P02.19)
19: External interrupt B.B. input (Base Block)
20: Warning output
21: Over-voltage
22: Over-current stall prevention
23: Over-voltage stall prevention
24: Operation mode
25: Forward command
26: Reverse command
29: Output when frequency ≥ P02.34
30: Output when frequency < P02.34
31: Y-connection for the motor coil
32: Δ-connection for the motor coil
33: Zero speed (actual output frequency)
34: Zero speed including STOP (actual output frequency)
35: Error output selection 1 (P06.23)
36: Error output selection 2 (P06.24)
37: Error output selection 3 (P06.25)
38: Error output selection 4 (P06.26)
40: Speed reached (including STOP)
42: Crane function
43: Motor speed detection
44: Low current output (use with P06.71–06.73)
45: UVW output electromagnetic valve switch
46: Master dEb output
51: Analog output control for RS-485 interface
53: Fire mode indication
67: Analog input level reached
69: Indication of Preheating
75: Forward RUN status
76: Reverse RUN status
77: Program Running Indication
78: Program Step Completed Indication
79: Program Running Completed Indication
80: Program Running Paused Indication
81: Multi-pump system error display (only master)

Use these parameters to set the function of multi-function terminals.

Summary of Function Settings

Setting	Function	Description
0	No Function	Output terminal with no function
1	Indication during RUN	Activates when the drive is not in STOP.
2	Operation speed reached	Activates when output frequency of drive reaches to the setting frequency.
3	Desired frequency reached 1 (P02.22)	Activates when the desired frequency (P02.22) is reached.
4	Desired frequency reached 2 (P02.24)	Activates when the desired frequency (P02.24) is reached.
5	Zero speed (Frequency command)	Activates when Frequency command = 0. (the drive must be in RUN status)
6	Zero speed including STOP (Frequency command)	Activates when Frequency command = 0 or stopped.
7	Over-torque 1	Activates when the drive detects over-torque. P06.07 sets the over-torque detection level (motor 1), and P06.08 sets the over-torque detection time (motor 1). Refer to P06.06–P06.08.
8	Over-torque 2	Activates when the drive detects over-torque. P06.10 sets the over-torque detection level (motor 2), and P06.11 sets the over-torque detection time (motor 2). Refer to P06.09–P06.11.
9	Drive is ready	Activates when the drive is ON with no error detected.
10	Low voltage warning (Lv)	Activates when the DC bus voltage is too low. (refer to P06.00 Low Voltage Level)
11	Malfunction indication	Activates when fault occurs (except Lv stop).
13	Overheat warning	Activates when IGBT or heat sink overheats to prevent the drive from shutting down due to overheating. (refer to P06.15)
14	Software brake signal indication	Activates when the soft brake function is ON. (refer to P07.00).
15	PID feedback error (P08.13, P08.14)	Activates when the PID feedback signal error is detected.
16	Slip error (oSL)	Activates when the slip error is detected.
17	Count value reached, does not return to 0 (P02.20)	When the drive executes external counter, this contact activates if the count value is equal to the setting value for P02.20. This contact deactivates when the setting value for P02.20 > P02.19.
18	Count value reached, returns to 0 (P02.19)	When the drive executes the external counter, this contact activates if the count value is equal to the setting value for P02.19.
19	External interrupt B.B. input (Base Block)	Activates when external interrupt (B.B.) stop output occurs in the drive.
20	Warning output	Activates when a warning is detected.
21	Over-voltage	Activates when over-voltage is detected.
22	Over-current stall prevention	Activates when the over-current stall prevention is detected.
23	Over-voltage stall prevention	Activates when over-voltage stall prevention is detected.
24	Operation mode	Activates when the source of operation command is not controlled by the digital keypad (P00.21 ≠ 0).
25	Forward command	Activates when the operation direction is forward.
26	Reverse command	Activates when the operation direction is reverse.
29	Output when frequency ≥ P02.34	Activates when frequency is ≥ P02.34 (actual output H ≥ P02.34).
30	Output when frequency < P02.34	Activates when frequency is < P02.34 (actual output H < P02.34).
31	Y-connection for the motor coil	Activates when P05.24 = 1, the frequency output is lower than P05.23 minus 2 Hz and the time is longer than P05.25.
32	Δ-connection for the motor coil	Activates when P05.24 = 1, the frequency output is higher than P05.23 plus 2 Hz and the time is longer than P05.25.

Setting	Function	Description
33	Zero speed (actual output frequency)	Activates when the actual output frequency is 0 (the drive is in RUN mode).
34	Zero speed including stop (actual output frequency)	Activates when the actual output frequency is 0 or stopped.
35	Error output selection 1 (P06.23)	Activates when P06.23 is ON.
36	Error output selection 2 (P06.24)	Activates when P06.24 is ON.
37	Error output selection 3 (P06.25)	Activates when P06.25 is ON.
38	Error output selection 4 (P06.26)	Activates when P06.26 is ON.
40	Speed reached (including Stop)	Activates when the drive's output frequency reaches the setting frequency or stopped.
42	Crane function	Use this function with P02.34 and P02.58. Refer to P02.34 and P02.58 for details and application examples.
43	Actual motor speed detection	Activates when using the DI5 as pulse input signal and motor actual speed is less than P02.47.
44	Low current output	Use this function with P06.71–P06.73.
45	UVW output electromagnetic valve switch	Use this function with any multifunction input = 49 (drive enabled) and multifunction output = 45 (electromagnetic valve enabled), and then the electromagnetic valve is ON or OFF according to the status of the drive.  
46	Master dEb output	When dEb rises at the master, DO1 sends a dEb signal to the slave. Output the message when the master triggers dEb. This ensures that the slave also triggers dEb. Then the slave follows the deceleration time of the master to stop simultaneously with the master.
51	Analog output control for RS-485 interface	For RS-485 communication control output.
53	Fire mode indication	Activates when DI setting 58 or 59 is enabled.

Setting	Function	Description
67	Analog input level reached output	The multi-function output terminals operate when the analog input level is between the high level and the low level. • P03.44: Select the analog input channel (AI-V, AI-C) to be compared. • P03.45: The high level for the analog input, default is 50%. • P03.46: The low level for the analog input, default is 10%. • If analog input > P03.45, the multi-function output terminal operates. • If analog input < P03.46, the multi-function output terminal stops output.
69	Indication of Preheating	Active when preheating function is enabled.
75	Forward RUN status	When the drive runs FWD, the output terminal for forward running is closed; when the drive stops, the output terminal for forward running is open.
76	Reverse RUN status	When the drive runs REV, the output terminal for reverse running is closed; when the drive stops, the output terminal for reverse running is open.
77	Program Running Indication	Closed when running program auto-run.
78	Program Step Completed Indication	Closed for only 0.5 second whenever completing one step during program auto-run.
79	Program Running Completed Indication	Closed for only 0.5 seconds when the program auto-run completes all steps.
80	Program Running Paused Indication	Closed when the action of auto-run terminals are paused externally during program auto-run.
81	Multi-pump system error display (only Master)	Closed when errors occur on all drives for the multi-pump system.

		Type	Hex Addr	Dec Addr
P02.18	**Multi-function Output Direction**	♦R/W	0212	40531
	Range/Units (Format: 16-bit unsigned)	Default		
	0000h–FFFFh (0:N.O.; 1:N.C.)	0000h		

The parameter value will be displayed/entered in decimal format on the drive keypad or in GSoft2. If using the GS4-KPD, the value will be displayed/entered in hexadecimal format. This parameter is set by a bit. If the bit is 1, the corresponding multi-function output acts in an opposite way.

Example:

Assume P02.13 = 1. If the output is positive, and the bit is set to 0, then the Relay is ON when the drive runs and is OFF when the drive stops. Conversely, if the output is negative, and the bit is set to 1, then the Relay is OFF when the drive runs and is ON when the drive stops.

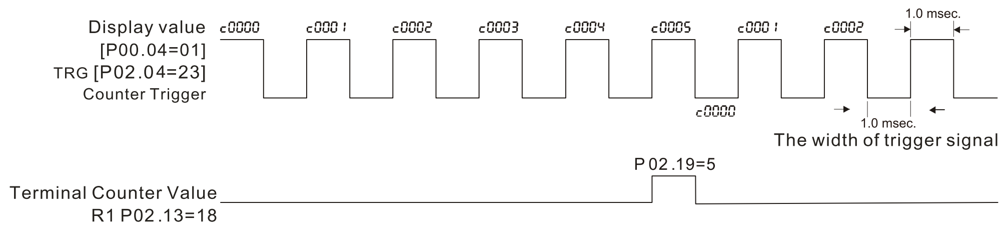
bit 3	bit 2	bit 1	bit 0
DO1	Reserved	Reserved	R1

NOTE: Use this parameter to set digital outputs ON/OFF with remote communications.

		Type	Hex Addr	Dec Addr
P02.19	***Terminal Counting Value Reached (returns to 0)***	♦R/W	0213	40532
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–65500	0		

The counting function is enabled when P02.19≠0.

- *You can set the input point for the counter using the multifunction input terminal DI4 as a trigger terminal (set P02.04 to 23). When counting is completed, the specified multi-function output terminal is activated (P02.13 or P02.16 is set to 18).*
- *The timing diagram below shows that when counting to 5, R1 activates and displays 0.*

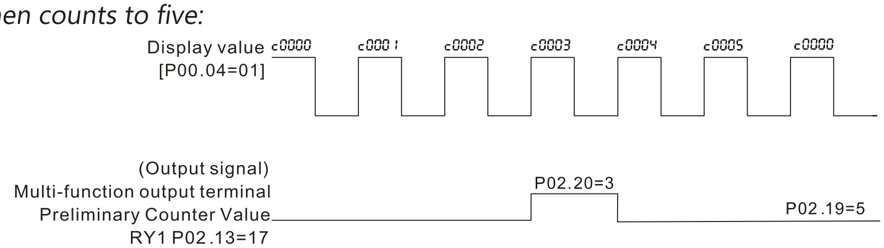


The timing diagram of
the external counting terminals and the counting value reached

		Type	Hex Addr	Dec Addr
P02.20	***Preliminary Counting Value Reached (does not return to 0)***	♦R/W	0214	40533
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–65500	0		

Use this parameter in conjunction with P02.19.

- *When the count value counts from 1 to reach this value, the corresponding multi-function output terminal is activated (P02.13 or P02.16 is set to 17) and keeps counting to the last count value.*
- *Use this parameter as the end of counting to make the drive run from the low speed to stop.*
- *The timing diagram shows R1 activates when the count value is three, and the display returns to zero when counts to five:*



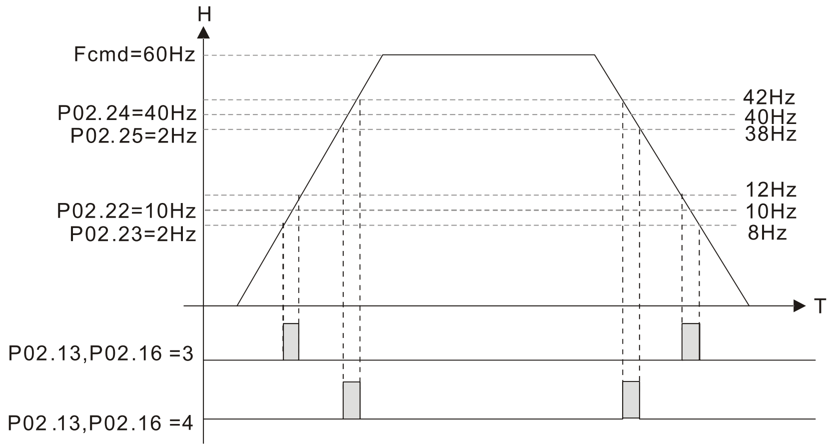
The timing diagram of
the external counting terminals and the counting value reached

		Type	Hex Addr	Dec Addr	Default
P02.22	***Desired Frequency Reached 1***	♦R/W	0216	40535	60.00/50.00
P02.23	***The Width of the Desired Frequency Reached 1***	♦R/W	0217	40536	2.00
P02.24	***Desired Frequency Reached 2***	♦R/W	0218	40537	60.00/50.00
P02.25	***The Width of the Desired Frequency Reached 2***	♦R/W	0219	40538	2.00

Range/Units (Format: 16-bit unsigned)

0.00–599.0 Hz

Use these parameters to close multi-function output terminals when the specified conditions are met. Once the output speed (frequency) reaches the desired speed (frequency), if the corresponding multi-function output terminal is set to 3 or 4 (P02.13 or P02.16), this multi-function output terminal is “closed”.



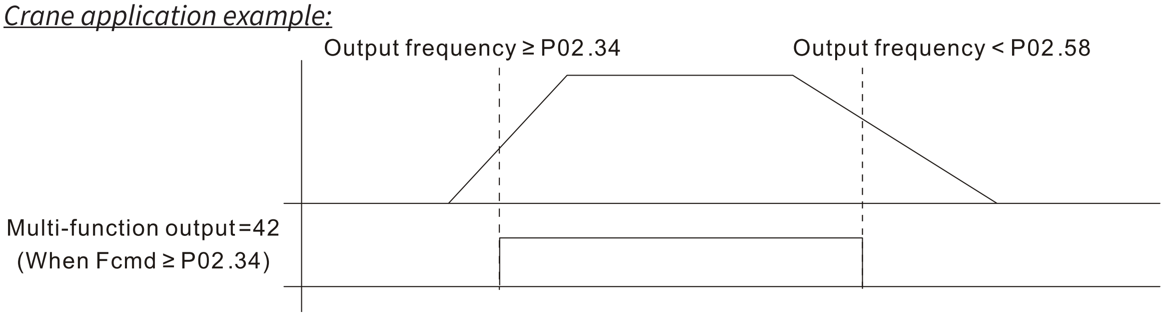
		Type	Hex Addr	Dec Addr
P02.34	***Output Frequency Setting for Multi-function Output Terminal***	♦R/W	0222	40547
P02.58	***Multi-function Output Terminal (Function 42): Brake Frequency Check Point***	♦R/W	023A	40571

Range/Units (Format: 16-bit unsigned)	Default
0.00–599.0 Hz	0.00

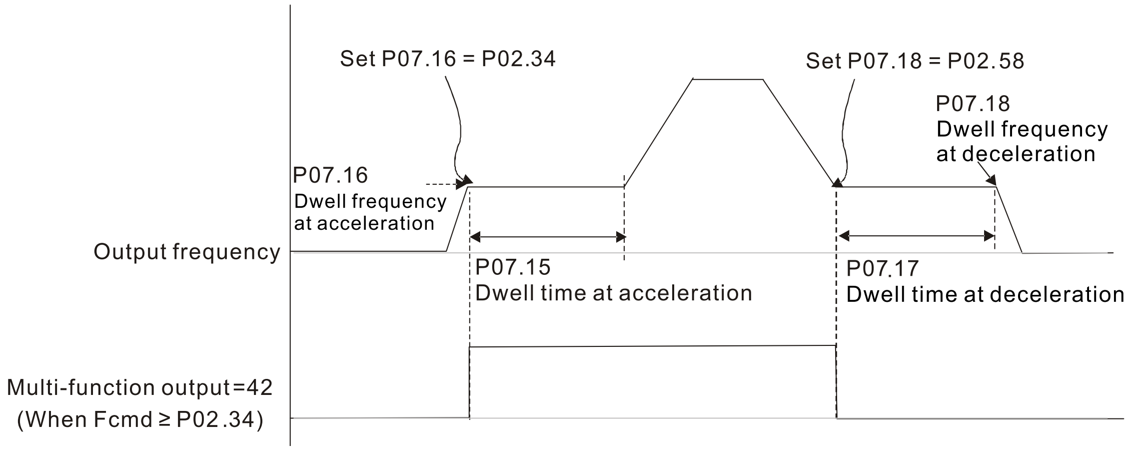
Use P02.34 with P02.58 for the crane function. Configure multifunction outputs P02.13, P02.16, and/or P02.17 with a terminal setting of 42: Crane function.

- *When the output frequency (H) is lower than the setting for P02.58, multi-function output terminal setting 42 stops after the command breaks off.*
- *P02.58 must be lower than P02.34 when using multifunction output terminal setting=42.*

Crane application example:



It is recommended that you use this with the Dwell acceleration/deceleration function as shown in the following diagram.



		Type	Hex Addr	Dec Addr
P02.35	***External Operation Control Selection after Reset and Reboot***	♦R/W	0223	40548
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable	0		
	1: Drive runs if the RUN command remains after reset or reboot.			

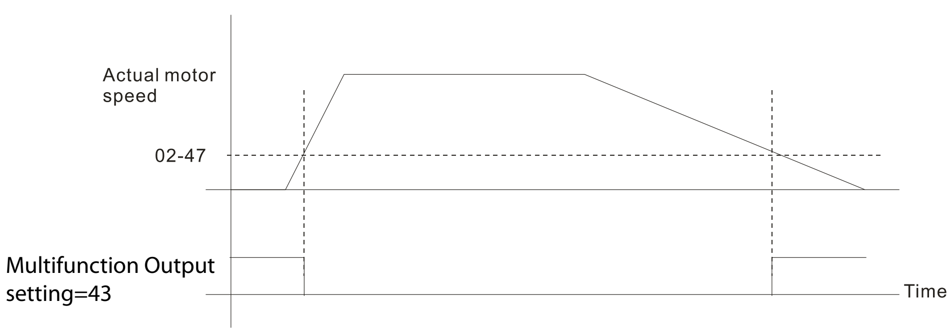
P02.35 allows the drive to resume running after a reset or reboot if an external control is still commanding it to RUN.

Setting value 1:

- *Situation 1: After the drive is powered up and the external terminal for RUN stays ON, the drive runs.*
- *Situation 2: After clearing a detected fault and while the external terminal for RUN stays ON, you can run the drive by pressing the RESET key.*

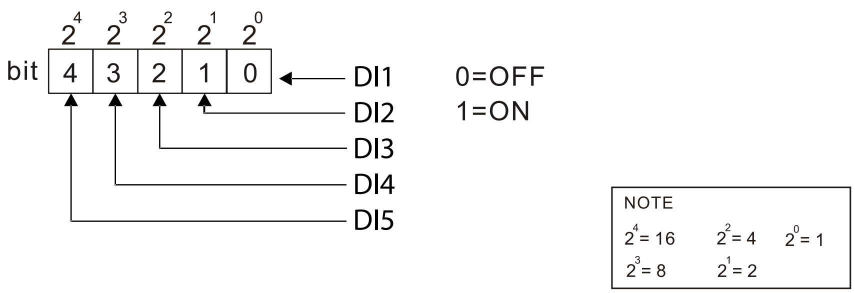
		Type	Hex Addr	Dec Addr
P02.47	***Motor Zero-speed Level***	♦R/W	022F	40560
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–65535 rpm	0		

Use this parameter with multifunction output=43 and set P10.00=5. Use this parameter to set the motor's speed level to zero-speed. When the actual speed is lower than this setting, the corresponding multi-function output terminal setting 43 is ON, as shown in the diagram below.



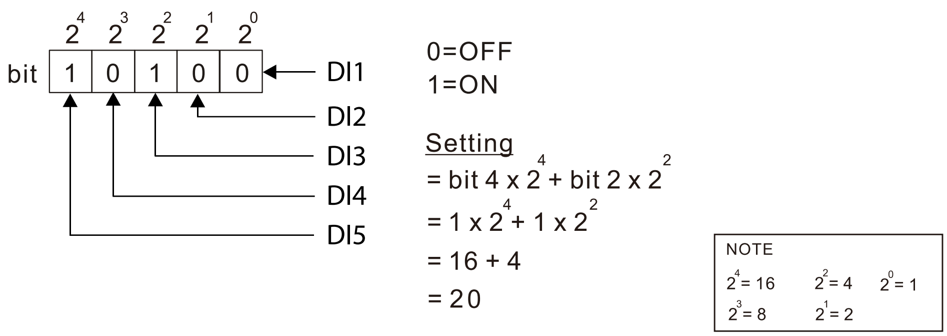
		Type	Hex Addr	Dec Addr
P02.50	***Display the Status of Multi-function Input Terminal***	Read	0232	40563
	Range/Units (Format: 16-bit unsigned)	*Default*		
	Monitor the status of the Multi-function Input Terminal	0		

P02.50 displays the status of the multi-function input terminals. Use the diagram below to interpret the display. The value will display in decimal on the keypad and must be converted to binary.



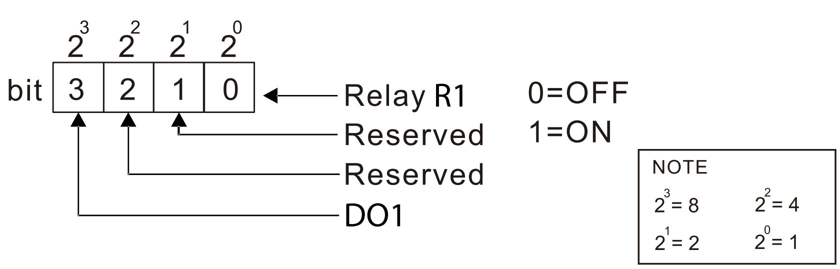
Example:

When P02.50 displays 20 (decimal) and 10100 (binary)), it means that DI3 and DI5 are ON.



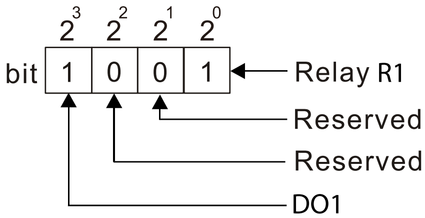
		Type	Hex Addr	Dec Addr
P02.51	***Display the Status of Multi-function Output Terminal***	Read	0233	40564
	Range/Units (Format: 16-bit unsigned)	*Default*		
	Monitor the status of the Multi-function Ouput Terminal	0		

P02.51 displays the status of the multi-function output terminals. Use the diagram below to interpret the display. The value will display in decimal on the keypad and must be converted to binary.



Example:

When P02.51 displays 0009h (hex) (9 (decimal) and 01001 (binary)), it means that Relay R1 and DO1 are ON.



0=OFF
1=ON

Setting
$= \text{bit } 3 \times 2^3 + \text{bit } 0 \times 2^0$
$= 1 \times 2^3 + 1 \times 2^0$
$= 8 + 1$
$= 9$

NOTE	
$2^3 = 8$	$2^2 = 4$
$2^1 = 2$	$2^0 = 1$

		Type	*Hex Addr*	*Dec Addr*
P02.54	***Display the Frequency Command Executed by External Terminal***	Read	0236	40567
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.0 Hz (Read only)	0		

When you set the source of the Frequency command as the external terminal, if LV or Fault occurs, the external terminal Frequency command is saved in this parameter.

		Type	*Hex Addr*	*Dec Addr*
P02.72	***Preheating Output Current Level***	R/W	0248	40585
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–100%	0		

This parameter controls the level of the preheating DC current input to the motor. The percentage of the preheating DC current equals to the percentage of motor rated current (P05.01).

Therefore, when you set this parameter, increase the level slowly to reach the desired preheating temperature.

Related parameters:

- *P02.73 Preheating DC Current Duty Cycle*
- *P02.13 and 16 Multi-function Output Relay 69: Indication of Preheating Function*
- *P02.01–05 Multi-function Input Terminal 69: Auto-activate preheating function.*

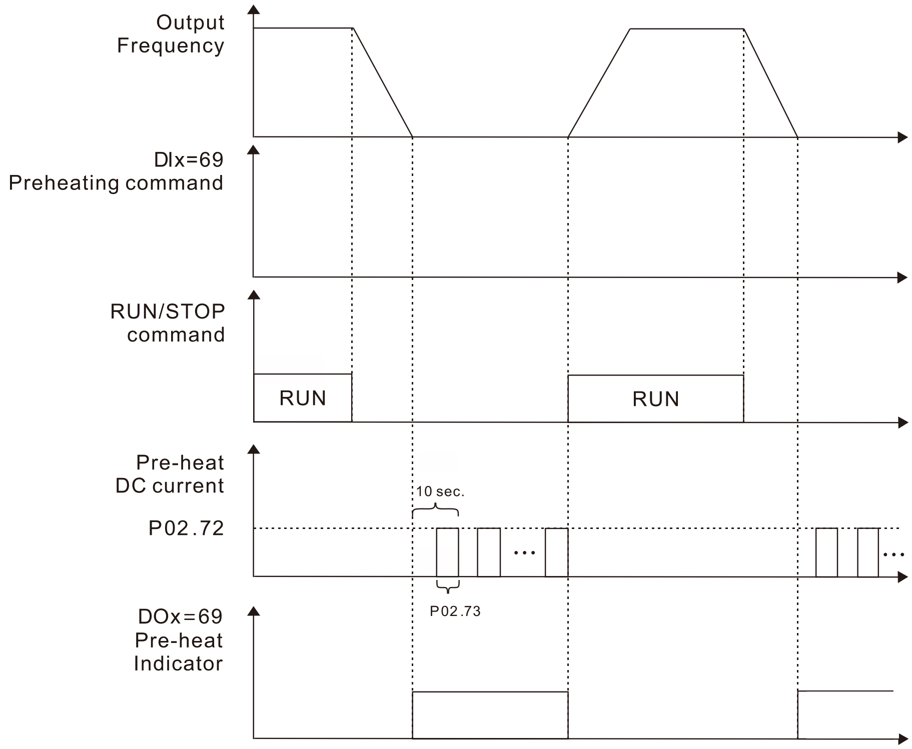
		Type	*Hex Addr*	*Dec Addr*
P02.73	***Preheating Output Cycle***	R/W	0249	40586
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–100%	0		

This parameter is to set up the duty cycle of the preheating DC current input to the motor. 0– 100% corresponds to 0–10 sec. If the setting is 0%, there is no output current from the motor drive. If the setting is 100%, there is continuous output DC current.

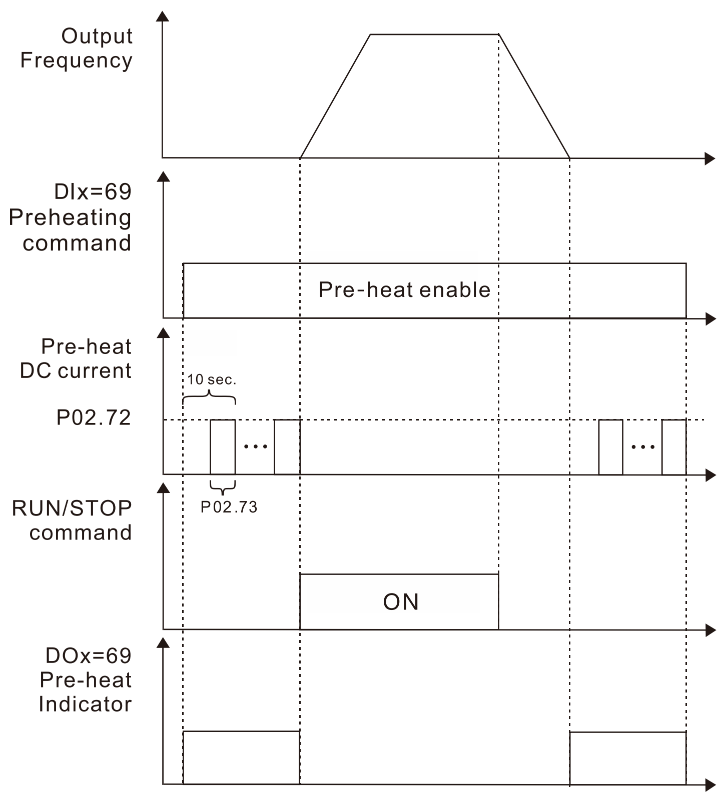
For example, when the setting of this parameter is 50%, the cycle time is the time spent to input current to motor for 5 seconds and stop inputting for 5 seconds. When DIx #69 is enabled, this parameter operates periodically with DIx #69 until the motor drive starts to run the motor or until DIx # 69 is disabled.

- *Preheating function works only when the setting value for P02.72 and P02.73 are not 0.*
- *When DIx = 69 (auto-activate preheating function) is enabled, DIx = 69 controls the start and stop of preheating function.*
- *When DIx = 69 is DISABLED, the preheating function starts after:*
- *The motor drive stops its first operation. The motor drive cycles the power.*

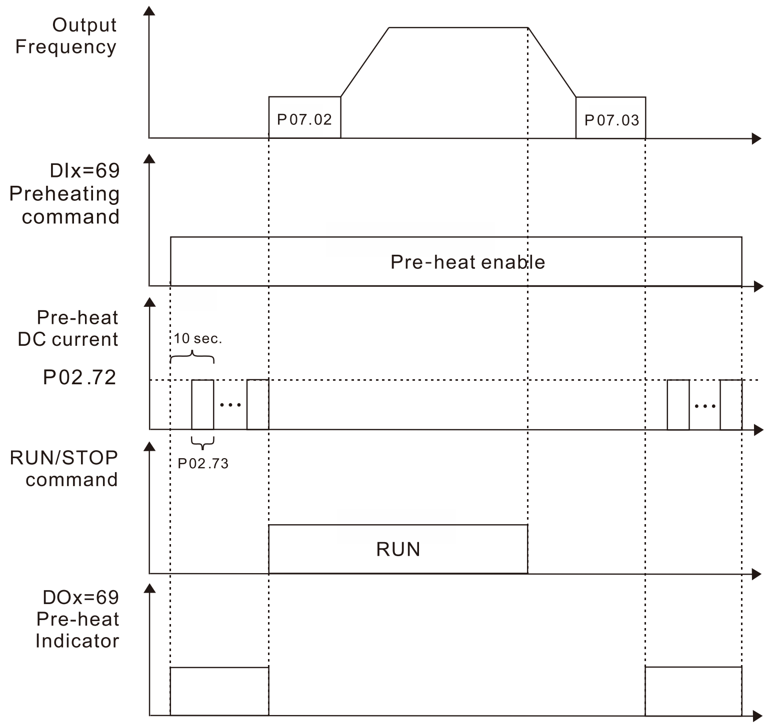
The figure below shows the timing relationship when DIx = 69 auto-activate preheating function is enabled and when preheating DC current is enabled and cycle time is 50%.



The figure below shows the timing relationship when DIx = 69 auto-activate preheating function is disabled and when preheating DC current is enabled and cycle time is 50%. When the motor drive is stopped, the preheating function starts to output DC current continuously.



The figure below shows the timing relationship between preheating function and enabling DC brake.



		Type	Hex Addr	Dec Addr
P02.81	***EF Activates when the Terminal Count Value Reached***	♦R/W	0251	40594
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Terminal count value reached, no EF displays (continues to operate) 1: Terminal count value reached, EF activates	0		

		Type	Hex Addr	Dec Addr
P02.82	***Initial Frequency Command (F) Mode after Stop***	♦R/W	0252	40595
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Use current Frequency command 1: Use zero Frequency command 2: Refer to P02.83 to set up	0		

		Type	Hex Addr	Dec Addr
P02.83	***Initial Frequency Command (F) Setting after Stop***	♦R/W	0253	40596
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.0 Hz	60.00		

Group P03.xx Details – Analog Input/Output Parameters

		Type	Hex Addr	Dec Addr	Default
P03.00	**Analog Input Selection (AI))**	♦R/W	0300	40769	1

Range/Units (Format: 16-bit binary)

0: No function
1: Frequency command
4: PID target value
5: PID feedback signal
6: Thermistor (PTC) input value
11: PT100 RTD input value
12: Auxiliary frequency input
13: PID compensation value

The AI terminal can be configured to function as a voltage input (AI-V) or a current input (AI-C) from the AI Dip Switch. AI-V parameters are for use when the dip switch is set for 0-10V and AI-C parameters are for use when set to 0(4) - 20mA.

- *P03.00 assigns the analog input function for both AI-V and AI-C modes.*
- *When using the analog input as the PID reference target, you must set P00.20 to 2 (external analog input).*
- *Setting method 1: P03.00 set 1 as PID reference target input.*
- *Setting method 2: P03.00 set 4 as PID reference target input.*
- *When you use analog input as the PID compensation value, you must set P08.16 to 1 (source of PID compensation value is analog input).You can see the compensation value with P08.17.*
- *When using the Frequency command, the corresponding value for 0–10 V / 4–20 mA is 0–maximum operation frequency (P01.00).*

		Type	Hex Addr	Dec Addr
P03.03	**Analog Input Bias (AI-V)**	♦R/W	0302	40771

Range/Units (Format: 16-bit signed) — *Default*

-100.0–100.0 % — 0

P03.03 sets the corresponding AI-V voltage for the external analog input. P03.50 must be set to zero for this parameter to be active. See analog input examples at the end of this section for further explanation of bias/gain settings.

		Type	Hex Addr	Dec Addr
P03.04	**Analog Input Bias (AI-C)**	♦R/W	0303	40772

Range/Units (Format: 16-bit signed) — *Default*

-100.0–100.0 % — 0

P03.04 sets the corresponding AI-C current for the external analog input. P03.50 must be set to zero for this parameter to be active. See analog input examples at the end of this section for further explanation of bias/gain settings.

		Type	Hex Addr	Dec Addr
P03.07	**Positive / Negative Bias Mode (AI-V)**	♦R/W	0304	40773
P03.08	**Positive / Negative Bias Mode (AI-C)**	♦R/W	0308	40777

Range/Units (Format: 16-bit binary) — *Default*

0: No bias — 0
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Using negative bias to set the frequency greatly reduces noise interference. In a noisy environment, do NOT use signals less than 1V to set the drive's operation frequency. P03.50 must be set to zero for these parameters to be active. See analog input examples at the end of this section for further explanation of bias/gain settings.

		Type	Hex Addr	Dec Addr
P03.10	***Reverse Setting when Analog Signal Input is Negative Frequency***	♦R/W	030A	40779
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Negative frequency input is not allowed. The digital keypad or external terminal controls the forward and reverse direction. 1: Negative frequency input is allowed. Positive frequency = run in a forward direction; negative frequency = run in a reverse direction. The digital keypad or external terminal control cannot change the running direction.	0		

Use this parameter for AI-V or AI-C analog input.

Requirements for negative frequency (reverse running):

1) P03.10 = 1
2) P03.07/P03.08 Bias mode = 4: Bias serves as the center
3) P03.11/P03.12 analog input gain < 0 (negative); this makes the input frequency negative. When using the analog input addition function (P03.18=1), if the analog signal is negative after the addition, you can set this parameter to allow or not allow the reverse running. The result after adding depends on the "Requirements for negative frequency (reverse running)".

P03.50 must be set to zero for this parameter to be active.

See analog input examples at the end of this section for further explanation of bias/gain settings.

		Type	Hex Addr	Dec Addr
P03.11	***Analog Input Gain (AI-V)***	♦R/W	030B	40780
P03.12	***Analog Input Gain (AI-C)***	♦R/W	030C	40781
	Range/Units (Format: 16-bit signed)	*Default*		
	-500.0–500.0 %	100.0		

P03.03–P03.12 are used when the Frequency command source is the analog voltage or current signal. P03.50 must be set to zero for these parameters to be active.

See analog input examples at the end of this section for further explanation of bias/gain settings.

		Type	Hex Addr	Dec Addr
P03.15	***Analog Input Filter Time (AI-V)***	♦R/W	030F	40784
P03.16	***Analog Input Filter Time (AI-C)***	♦R/W	0310	40785
	Range/Units (Format: 16-bit signed)	*Default*		
	0.00–20.00 sec.	0.01		

Analog signals, such as those entering AI-V and AI-C, are commonly affected by interference that affects the stability of the analog control. Use the Input Noise Filter to create a more stable system.

- *When the time constant setting is too large, the control is stable but the control response is slow.*
- *When the time constant setting is too small, the control response is faster but the control may be unstable.*
- *For optimal setting, adjust the setting based on the control stability or the control response.*

		Type	Hex Addr	Dec Addr
P03.19	***Signal Loss Selection for the Analog Input 4–20 mA***	R/W	0313	40788
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable 1: Continue operation at the last frequency 2: Decelerate to 0Hz 3: Stop immediately and display “ACE”	0		

Determines the treatment when the 4–20 mA signal is lost (AI-C (P03.28 = 2)).

- *This parameter is only valid when P03.28 =2 and the AI dip switch is set to current mode.*
- *When the setting is 1 or 2, the keypad displays the warning code “ANL”. It keeps blinking until the AI-C signal is recovered.*
- *When the drive stops, the condition that causes the warning does not exist , so the warning automatically disappears.*

		Type	Hex Addr	Dec Addr
P03.20	***Multi-function Output (AO1)***	♦R/W	0314	40789
	Range/Units (Format: 16-bit binary)	*Default*		
	0–23	0		

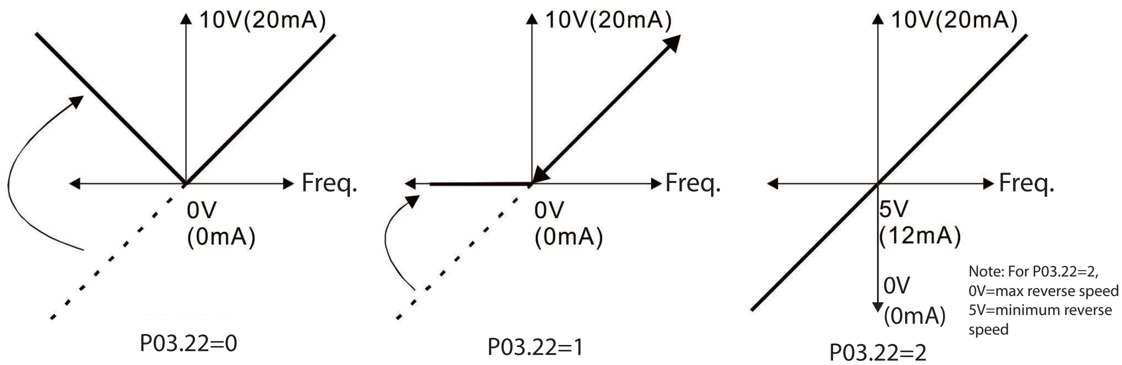
Summary of Function Settings

Setting	Function	Description
0	Output frequency (Hz)	Maximum frequency P01.00 is processed as 100 %.
1	Frequency command (Hz)	Maximum frequency P01.00 is processed as 100 %.
2	Motor speed (Hz)	Maximum frequency P01.00 is processed as 100 %.
3	Output current (rms)	(2.5 X drive rated current) is processed as 100 %.
4	Output voltage	(2 X motor rated voltage) is processed as 100 %.
5	DC bus voltage	120V/230V series: 450V = 100 % 460V series: 900V = 100 %
6	Power factor	-1.000–1.000 = 100 %
7	Power	(2 X drive rated power) is processed as 100 %.
8	Output torque	Full-load torque = 100 %
9	AI	[0–10 V] or [0(4) - 20mA] = 0–100 %
12	Iq current command	(2.5 X drive rated current) is processed as 100 %.
13	Iq feedback value	(2.5 X drive rated current) is processed as 100 %.
14	Id current command	(2.5 X drive rated current) is processed as 100 %.
15	Id feedback value	(2.5 X rated current) is processed as 100 %.
16	Vq-axis voltage command	120V/230V series: 250V = 100 % 460V series: 500V = 100 %
17	Vd-axis voltage command	120V/230V series: 250V = 100 % 460V series: 500V = 100 %
21	RS-485 analog output	For RS-485 (Modbus) control analog output **Terminal** / **Address**: AO1 / 26A0H
23	Constant voltage output	P03.32 controls the voltage output level. 0–100 % of P03.32 corresponds to 0–10 V for AO1.

		Type	Hex Addr	Dec Addr
P03.21	***Analog Output Gain (AO1)***	♦R/W	0315	40790
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–500.0 %	100.0		

P03.21 adjusts the voltage level output to the analog meter from the analog signal (P03.20) output terminal AO1 of the drive.

		Type	Hex Addr	Dec Addr
P03.22	***Analog Output in REV Direction (AO1)***	♦R/W	0316	40791
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Absolute value in output voltage 1: Reverse output 0 V; forward output 0–10 V 2: Reverse output 5-0 V; forward output 5–10 V	0		



		Type	Hex Addr	Dec Addr
P03.27	***AO1 Output Bias***	♦R/W	031B	40796
	Range/Units (Format: 16-bit signed)	*Default*		
	-100.00–100.00 %	0.00		

This parameter sets the corresponding voltage of the analog output 0.

Example 1:

AO1 0–10 V is set to the output frequency, the output equation is:

$$10\text{ V} \times \left(\frac{\text{Output Frequency}}{\text{Pr.01-00}}\right) \times \text{Pr.03-21} + 10\text{ V} \times \text{Pr.03-27}$$

Example 2:

AO1 0–20 mA is set to the output frequency, the output equation is:

$$20\text{ mA} \times \left(\frac{\text{Output Frequency}}{\text{Pr.01-00}}\right) \times \text{Pr.03-21} + 20\text{ mA} \times \text{Pr.03-27}$$

Example 3:

AO1 4–20 mA is set to the output frequency, the output equation is:

$$4\text{ mA} + 16\text{ mA} \times \left(\frac{\text{Output Frequency}}{\text{Pr.01-00}}\right) \times \text{Pr.03-21} + 16\text{ mA} \times \text{Pr.03-27}$$

		Type	Hex Addr	Dec Addr
P03.28	***AI Terminal Input Selection***	♦R/W	031C	40797
	Range/Units (Format: 16-bit binary)	*Default*		
	0: 0–10 V (P03.63–03.68 is valid) 1: 0–20 mA (P03.57–03.62 is valid) 2: 4–20 mA (P03.57–03.62 is valid)	0		

Switch between voltage mode and current mode must match the AI Dip switch. Refer to Chapter 02 Control Wiring for more information on the AI terminal.

- *When you change the setting, proportion to the corresponding AI will change to default.*

		Type	Hex Addr	Dec Addr
P03.32	***AO1 DC Output Setting Level***	♦R/W	0320	40801
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–100.00 %	0.0		

		Type	Hex Addr	Dec Addr
P03.35	***AO1 Output Filter Time***	♦R/W	0323	40804
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–20.00 sec.	0		

		Type	Hex Addr	Dec Addr
P03.39	***VR Input Selection***	♦R/W	0327	40808
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable 1: Frequency command	1		

VR is the abbreviation for Variable Resistor; it is the potentiometer of the integrated GS10 drive digital keypad. The VR can be selected for use in P00.20, P00.30, and P00.35 with setting 7: Digital Keypad VR/Potentiometer Dial.

		Type	Hex Addr	Dec Addr
P03.40	***VR Input Bias***	♦R/W	0328	40809
	Range/Units (Format: 16-bit signed)	*Default*		
	-100–100 %	0.0		

		Type	Hex Addr	Dec Addr
P03.41	***VR Positive / Negative Bias***	♦R/W	0329	40810
	Range/Units (Format: 16-bit binary)	*Default*		
	0: No bias 1: Lower than or equal to bias 2: Greater than or equal to bias 3: The absolute value of the bias voltage while serving as the center 4: Bias serves as the center	0		

		Type	Hex Addr	Dec Addr
P03.42	***VR Gain***	♦R/W	032A	40811
	Range/Units (Format: 16-bit signed)	*Default*		
	-500.0–500.0 %	100.0		

		Type	Hex Addr	Dec Addr
P03.43	***VR Filter Time***	R/W	032B	40812
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–2.00 sec.	0.01		

		Type	Hex Addr	Dec Addr
P03.44	***Multi-function Output (DOx) by AI Level Source***	♦R/W	032C	40813
	Range/Units (Format: 16-bit binary)	*Default*		
	0: AI-V 1: AI-C	0		

		Type	Hex Addr	Dec Addr
P03.45	***DOx - AI Upper Level***	♦R/W	032D	40814
	Range/Units (Format: 16-bit signed)	*Default*		
	-100–100 %	50		

		Type	Hex Addr	Dec Addr
P03.46	***DOx - AI Lower Level***	♦R/W	032E	40815
	Range/Units (Format: 16-bit signed)	*Default*		
	-100–100 %	10		

Use parameters P03.44–P03.46 with multi-function output setting 67: (analog input level reached) on P02.13 or P02.16. The digital output is active when the AI input level is higher than P03.45. The digital output is disabled when the AI input is lower than P03.46.

When setting levels, P03.45 DOx-AI upper level must be higher than P03.46 DOx-AI lower level.

		Type	Hex Addr	Dec Addr
P03.50	***Analog Input Curve Selection***	♦R/W	0332	40819
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Normal curve 1: Three-point curve of AI-V 2: Three-point curve of AI-C	0		

This parameter determines use of the gain/bias settings or the three point curve settings to adjust the frequency output command.

- *P03.50=0: Normal Curve- This enables parameters P03.03, P03.04, P03.07, P03.10, P03.11, and P03.12 for AI. Proportional parameters are not used.*
- *P03.50=1:*
  Utilizes Parameters P03.63–P03.68. (if P03.28= 0) for AI-V. Keeps Gain/Bias for AI-C.
  Utilizes Parameters P03.63–P03.74 (if P03.28=3) Keeps Gain/Bias for AI-C.
- *P03.50=2:*
  Utilizes parameters P03.57–P03.62 for AI-C, Uses Gain/Bias for AI-V.

For ease of setup, 3-point curve is recommended. When 3-point curve mode is selected, P03.10 is not used. Forward/Reverse action is determined by the frequency polarity in the proportional parameters.

NOTE: See Analog Input Parameter examples section for setting up 3 point curve.

		Type	Hex Addr	Dec Addr
P03.57	***AI-C Lowest Point***	♦R/W	0339	40826
	Range/Units (Format: 16-bit unsigned)	Default		
	P03.28 = 1, 0.00–20.00 mA P03.28 = 2, 4.00–20.00 mA	4.00		

When the input current falls below this parameter, the action defined in P03.19 will initiate.

		Type	Hex Addr	Dec Addr
P03.58	***AI-C Proportional Lowest Point***	♦R/W	033A	40827
	Range/Units (Format: 16-bit unsigned)	Default		
	0.00–100.00 %	0.00		

		Type	Hex Addr	Dec Addr
P03.59	***AI-C Mid-point***	♦R/W	033B	40828
	Range/Units (Format: 16-bit unsigned)	Default		
	P03.28 = 1, 0.00–20.00 mA P03.28 = 2, 4.00–20.00 mA	12.00		

		Type	Hex Addr	Dec Addr
P03.60	***AI-C Proportional Mid-point***	♦R/W	033C	40829
	Range/Units (Format: 16-bit unsigned)	Default		
	0.00–100.00 %	50.00		

		Type	Hex Addr	Dec Addr
P03.61	***AI-C Highest Point***	♦R/W	033D	40830
	Range/Units (Format: 16-bit unsigned)	Default		
	P03.28 = 1, 0.00–20.00 mA P03.28 = 2, 4.00–20.00 mA	20.00		

		Type	Hex Addr	Dec Addr
P03.62	***AI-C Proportional Highest Point***	♦R/W	033E	40831
	Range/Units (Format: 16-bit unsigned)	Default		
	0.00–100.00 %	100.00		

- *When you set the analog input AI-C to the Frequency command, 100% corresponds to Fmax (P01.00 Maximum Operation Frequency).*
- *The requirement for the low, mid, and high point parameters (P03.57, P03.59 and P03.61) is P03.57 < P03.59 < P03.61. The values for three proportional points (P03.58, P03.60 and P03.62) have no limits. There is a linear calculation between two points.*
- *The output percentage becomes 0% when the AI-C input value is lower than the lowest point setting.*

Example:

If P03.57 = 2mA; P03.58 = 10%, then the output becomes 0% when the AI-C input is ≤ 2mA.

Once the AI-C input goes above 2mA, the drive's output frequency starts at 10%.

		Type	Hex Addr	Dec Addr
P03.63	***AI-V Voltage Lowest Point***	♦R/W	033F	40832
	Range/Units (Format: 16-bit unsigned)	Default		
	P03.28=0, 0.00–10.00 V	0.00		

		Type	Hex Addr	Dec Addr
P03.64	***AI-V Proportional Lowest Point***	♦R/W	0340	40833
	Range/Units (Format: 16-bit signed)	*Default*		
	-100.00–100.00 %	0.00		

		Type	Hex Addr	Dec Addr
P03.65	***AI-V Voltage Mid-point***	♦R/W	0341	40834
	Range/Units (Format: 16-bit unsigned)	*Default*		
	P03.28=0, 0.00–10.00 V	5.00		

		Type	Hex Addr	Dec Addr
P03.66	***AI-V Proportional Mid-point***	♦R/W	0342	40835
	Range/Units (Format: 16-bit signed)	*Default*		
	-100.00–100.00 %	50.00		

		Type	Hex Addr	Dec Addr
P03.67	***AI-V Highest Point***	♦R/W	0343	40836
	Range/Units (Format: 16-bit unsigned)	*Default*		
	P03.28=0, 0.00–10.00 V	10.00		

		Type	Hex Addr	Dec Addr
P03.68	***AI-V Proportional Highest Point***	♦R/W	0344	40837
	Range/Units (Format: 16-bit signed)	*Default*		
	-100.00–100.00 %	100.00		

When you set the positive voltage AI-V to the Frequency command, 100% corresponds to Fmax (P01.00 Maximum Operation Frequency) and the motor runs in the forward direction.

- *The requirement for the low, mid, and high point parameters (P03.63, P03.65, and P03.67) is P03.63 < P03.65 < P03.67. The values for three proportional points (P03.64, P03.66 and P03.68) have no limits. There is a linear calculation between two points.*
- *The output percentage becomes 0 % when the positive voltage AI-V input value is lower than the lowest point setting.*

Example:

If P03.63 = 1V; P03.64 = 10%, then the output becomes 0% when the AI-V input is ≤ 1V.

Once the AI-V input increases above 1V, the drive output frequency will start at 10%.

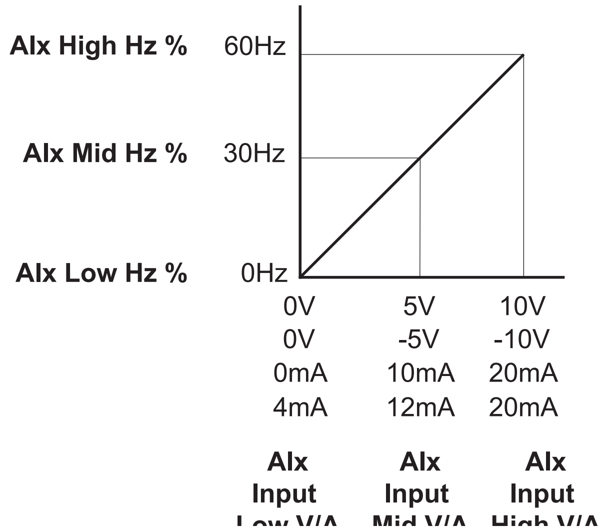
Analog Input Parameter Examples

Refer to the following equations and examples for changing the ratio of the analog input signal relative to the output frequency of the drive.

There are 2 methods of changing the ratio: Three point curve or Bias/Gain. Either method can be used and is largely a matter of user preference.

Three Point Curve (P03.50 ≠ 0):

The Three Point Curve parameters are used to set the low, mid, and high input signals corresponding to a low, mid, and high proportional output value. This method eliminates the need for using any mathematic equations by the user. A curve slope will be calculated automatically between the low and mid point values, and the mid and high point values.



Analog Input	AI-V	AI-C
Polarity	0–10 V	Positive (+)
Curve Selection	P03.50 = 1	P03.50 = 2
Low V/A	P03.63	P03.57
Low Hz Percent	P03.64	P03.58
Mid V/A	P03.65	P03.59
Mid Hz Percent	P03.66	P03.60
High V/A	P03.67	P03.61
High Hz Percent	P03.68	P03.62

Bias/Gain (P03.50 = 0: Normal Curve, default):

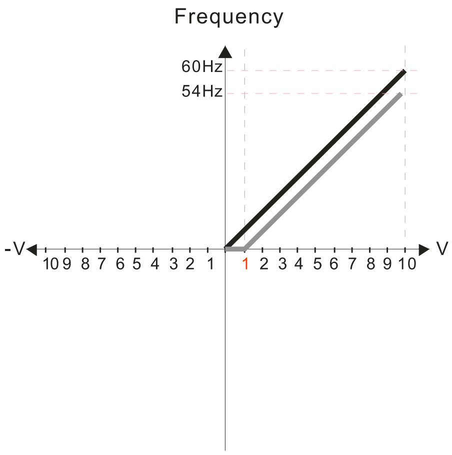
The Normal Curve setting utilizes 4 different parameters to modify the output frequency of the drive. The bias/gain parameters work in accordance with the Pos/Neg bias mode and reverse setting parameter. Use diagrams 1 - 32 to understand the frequency outputs that will result from these parameter settings.

Analog Input	AI-V	AI-C
Bias Parameter	P03.03	P03.04
Pos/Neg Bias Parameter	P03.07	P03.08
Gain Parameter	P03.11	P03.12
Analog Input Function	P03.00	
Reverse Setting Parameter	P03.10	
Curve Parameter	P03.50	
Drive Max Output Freq	P01.00	

Frequency output at default bias/gain settings

Manipulated frequency output based on listed parameter values

Bias and Gain Example 1:



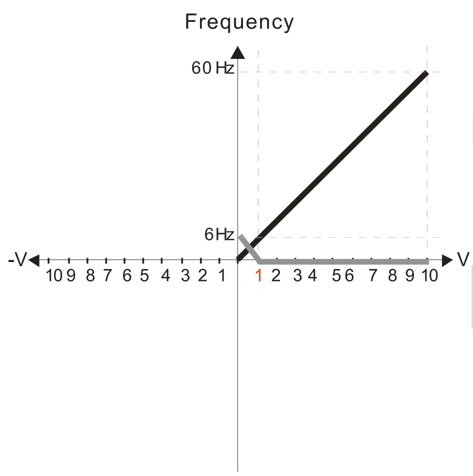
P03.03=10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI-V) = 100%

Bias and Gain Example 2:



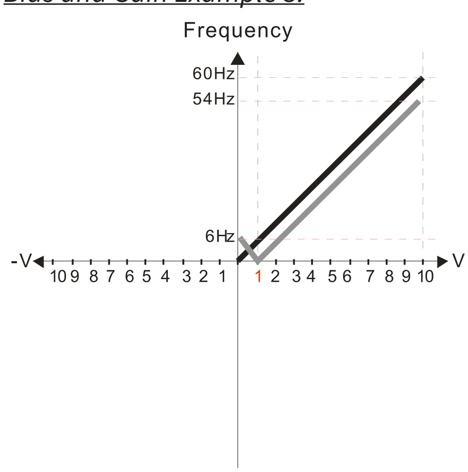
P03.03=10%
P03.07– P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI-V) = 100%

Bias and Gain Example 3:



P03.03=10%
P03.07–P03.08 (Positive/Negative Bias Mode)

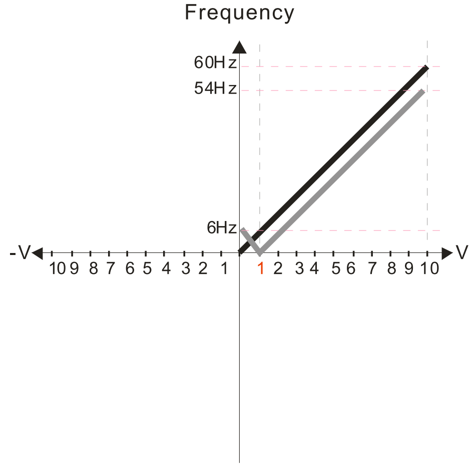
0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI-V) = 100%

Frequency output at default bias/gain settings
Manipulated frequency output based on listed parameter values

Bias and Gain Example 4:



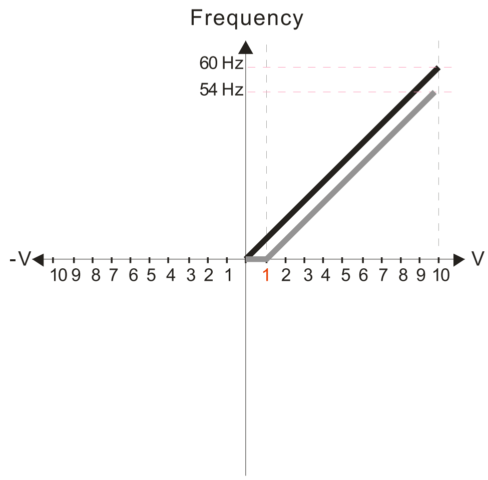
P03.03=10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI-V) = 100%

Bias and Gain Example 5:



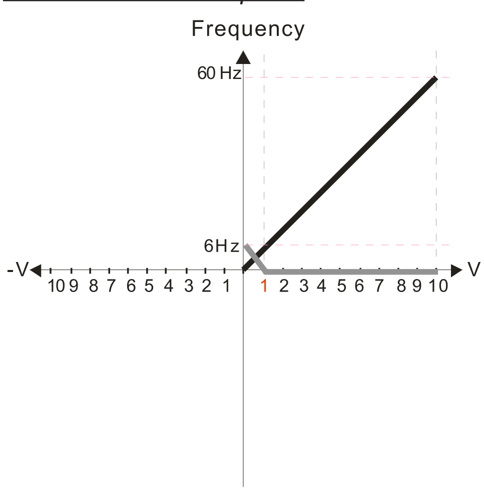
P03.03=10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI-V) = 100%

Bias and Gain Example 6:



P03.03=10%
P03.07–P03.08 (Positive/Negative Bias Mode)

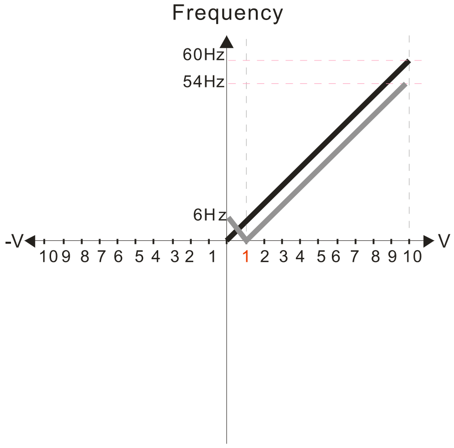
0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI-V) = 100%

Frequency output at default bias/gain settings
Manipulated frequency output based on listed parameter values

Bias and Gain Example 7:



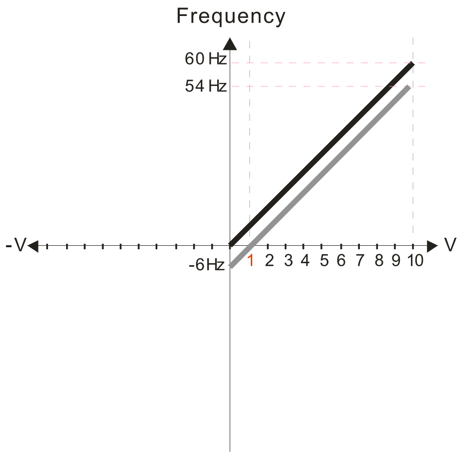
P03.03=10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI-V) = 100%

Bias and Gain Example 8:



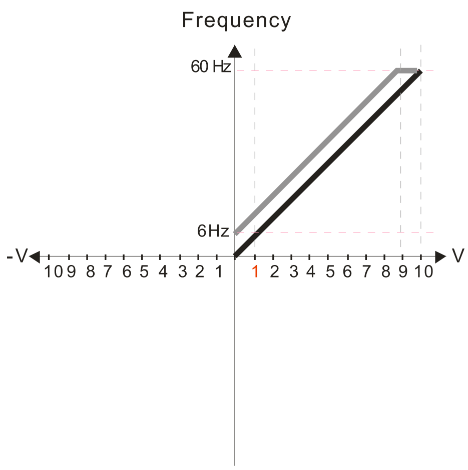
P03.03=10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI-V) = 100%

Bias and Gain Example 9:



P03.03=-10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

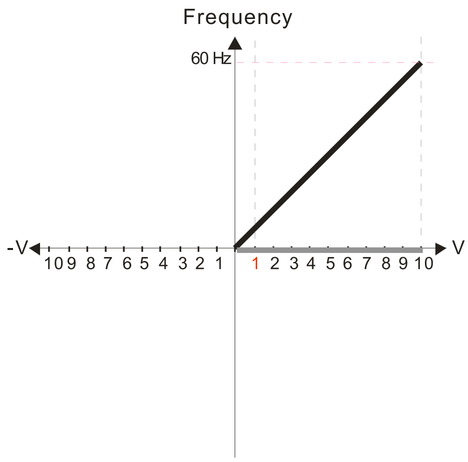
P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI-V) = 100%

Frequency output at default bias/gain settings

Manipulated frequency output based on listed parameter values

Bias and Gain Example 10:



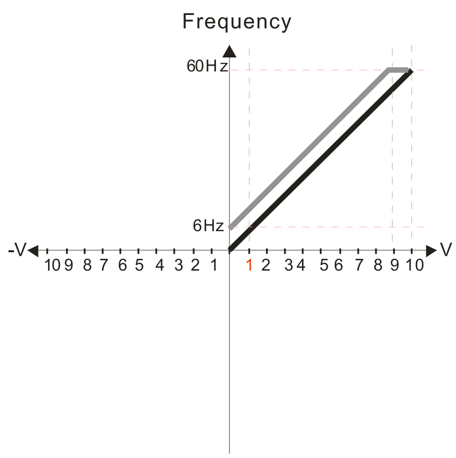
P03.03=-10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI-V) = 100%

Bias and Gain Example 11:



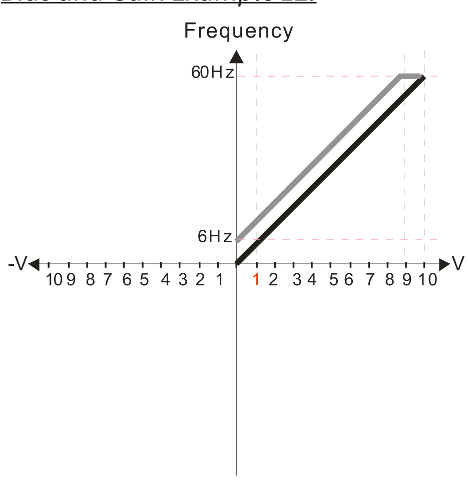
P03.03=-10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI-V) = 100%

Bias and Gain Example 12:



P03.03=-10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

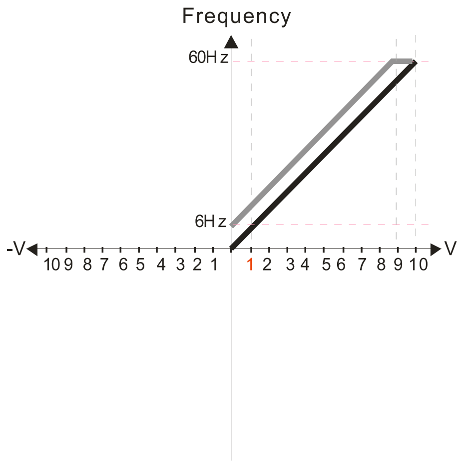
P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI-V) = 100%

Frequency output at default bias/gain settings

Manipulated frequency output based on listed parameter values

Bias and Gain Example 13:



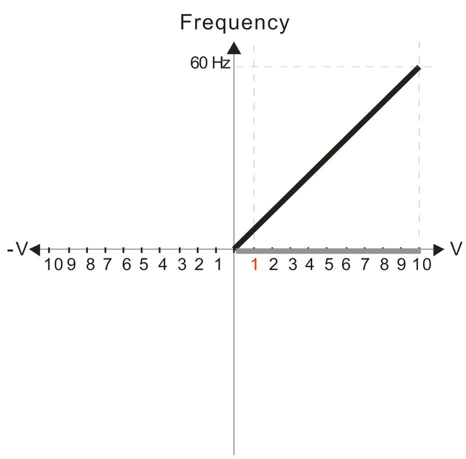
P03.03=-10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI-V) = 100%

Bias and Gain Example 14:



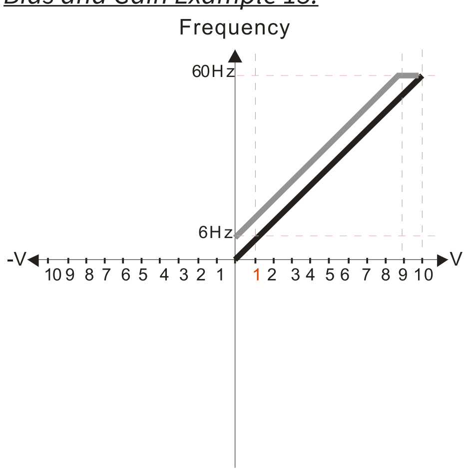
P03.03=-10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI-V) = 100%

Bias and Gain Example 15:



P03.03=-10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

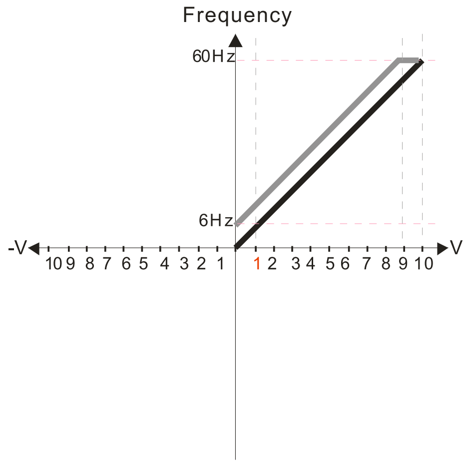
P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI-V) = 100%

Frequency output at default bias/gain settings

Manipulated frequency output based on listed parameter values

Bias and Gain Example 16:



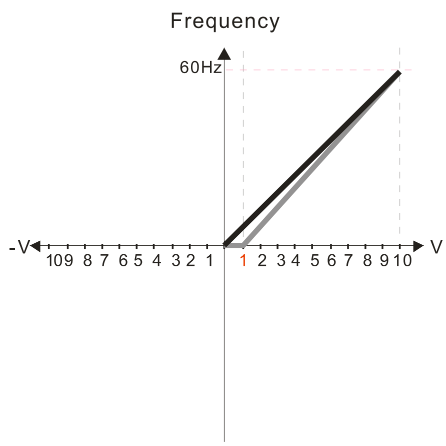
P03.03=-10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI-V) = 100%

Bias and Gain Example 17:



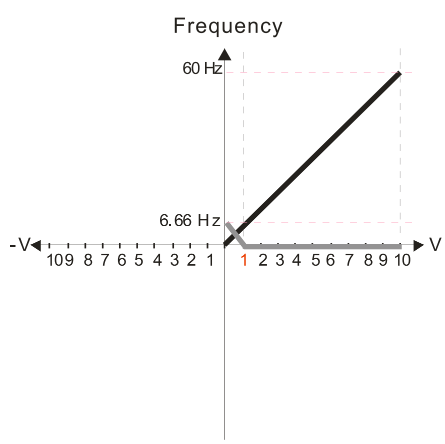
P03.03=10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI-V) = 111.1%
10/9 = 111.1%

Bias and Gain Example 18:



P03.03=10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

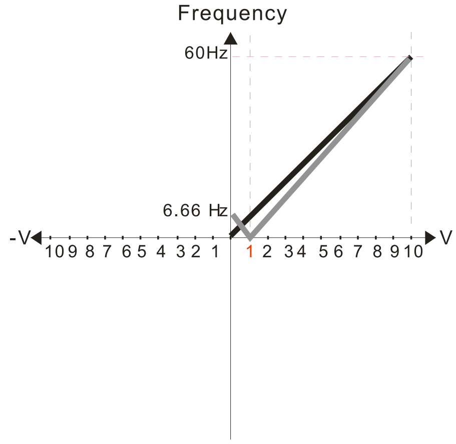
P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI-V) = 111.1%
10/9 = 111.1%

Frequency output at default bias/gain settings

Manipulated frequency output based on listed parameter values

Bias and Gain Example 19:



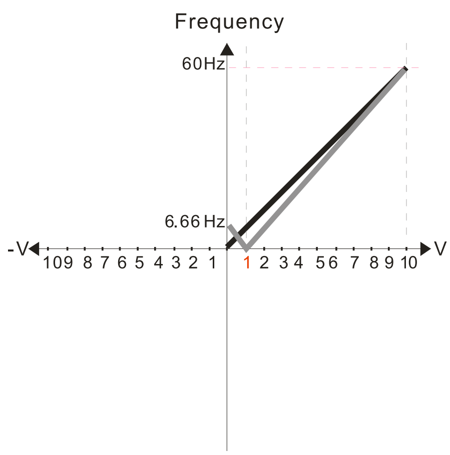
P03.03=10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI-V) = 111.1%
10/9 = 111.1%

Bias and Gain Example 20:



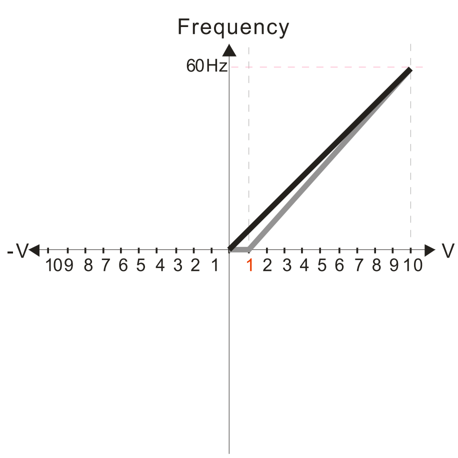
P03.03=10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI-V) = 111.1%
10/9 = 111.1%

Bias and Gain Example 21:



P03.03=10%
P03.07–P03.08 (Positive/Negative Bias Mode)

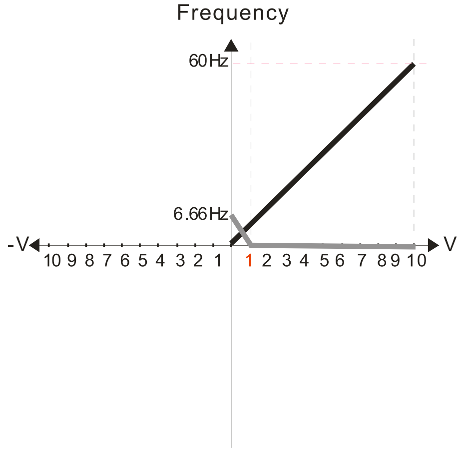
0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI-V) = 111.1%
10/9 = 111.1%

Frequency output at default bias/gain settings
Manipulated frequency output based on listed parameter values

Bias and Gain Example 22:



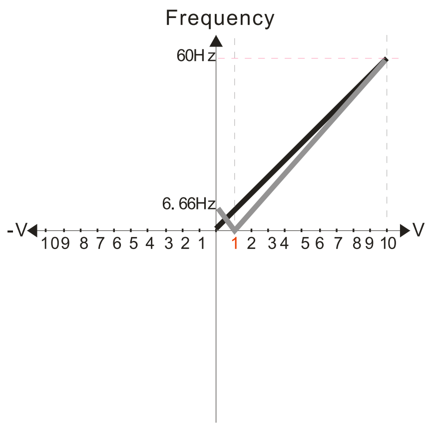
P03.03=10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI-V) = 111.1%
10/9 = 111.1%

Bias and Gain Example 23:



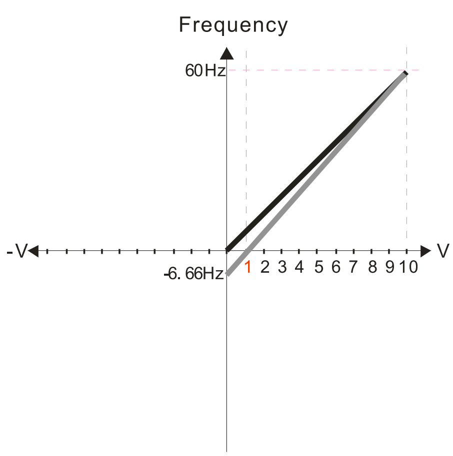
P03.03=10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI-V) = 111.1%
10/9 = 111.1%

Bias and Gain Example 24:



P03.03=10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

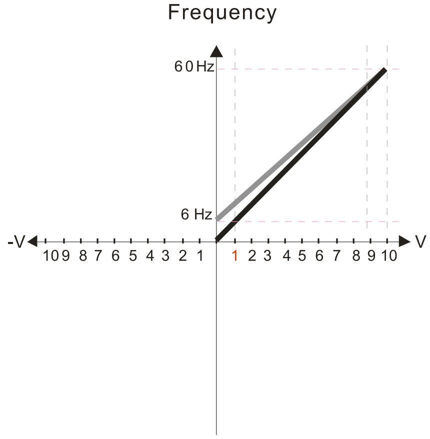
P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI-V) = 111.1%
10/9 = 111.1%

Frequency output at default bias/gain settings

Manipulated frequency output based on listed parameter values

Bias and Gain Example 25:



P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

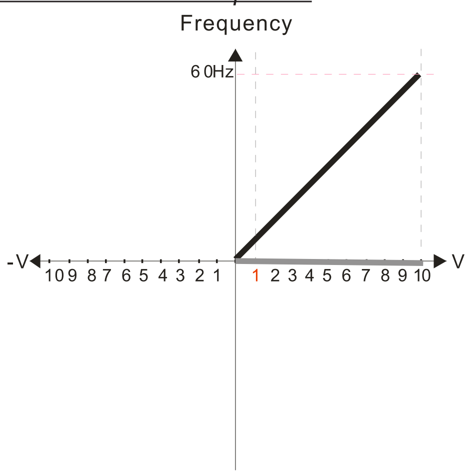
Calculate the bias:

$$\frac{60-6Hz}{10V} = \frac{6-0Hz}{(0-XV)} \quad XV = \frac{100}{-9} = -1.11V \quad \therefore 03\text{-}03 = \frac{-1.11}{10} \times 100\% = -11.1\%$$

Calculate the gain:

$$P03.11 = \frac{10V}{11.1V} \times 100\% = 90.0\%$$

Bias and Gain Example 26:

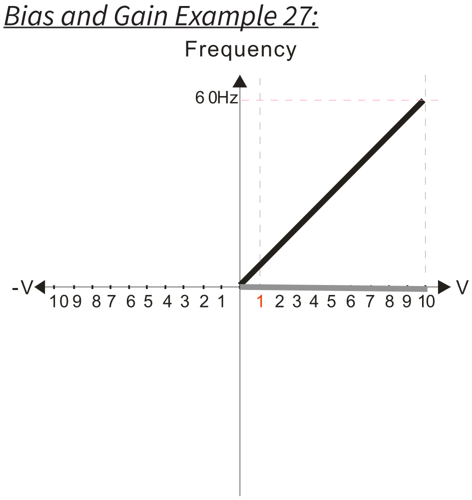


P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Bias and Gain Example 27:



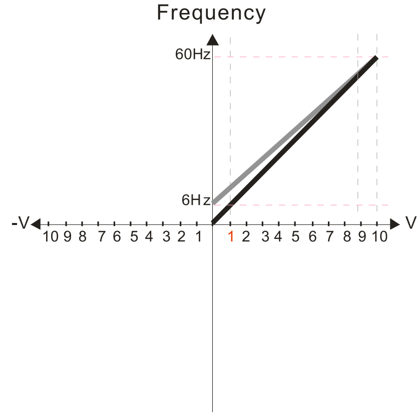
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Frequency output at default bias/gain settings
Manipulated frequency output based on listed parameter values

Bias and Gain Example 28:



P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

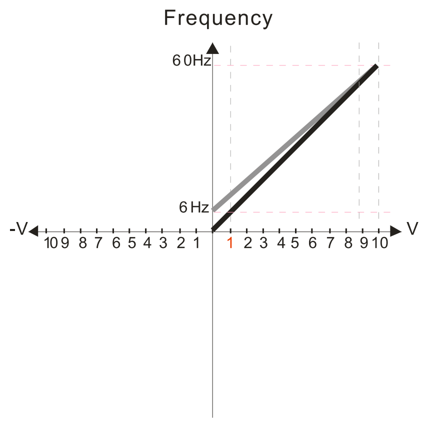
Calculate the bias:

$$\frac{60-6Hz}{10V} = \frac{6-0Hz}{(0-XV)} \quad XV = \frac{100}{-9} = -1.11V \quad \therefore 03\text{-}03 = \frac{-1.11}{10} \times 100\% = -11.1\%$$

Calculate the gain:

$$P03.11 = \frac{10V}{11.1V} \times 100\% = 90.0\%$$

Bias and Gain Example 29:



P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Calculate the bias:

$$\frac{60-6Hz}{10V} = \frac{6-0Hz}{(0-XV)} \quad XV = \frac{100}{-9} = -1.11V \quad \therefore 03\text{-}03 = \frac{-1.11}{10} \times 100\% = -11.1\%$$

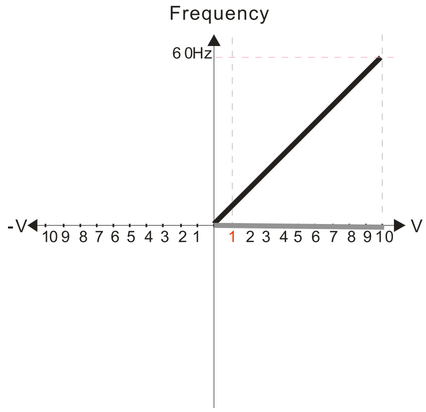
Calculate the gain:

$$P03.11 = \frac{10V}{11.1V} \times 100\% = 90.0\%$$

Frequency output at default bias/gain settings

Manipulated frequency output based on listed parameter values

Bias and Gain Example 30:

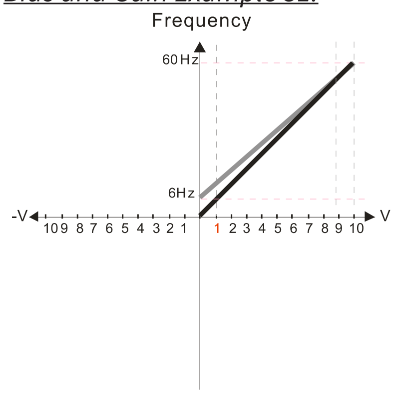


P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Bias and Gain Example 31:



P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Calculate the bias:

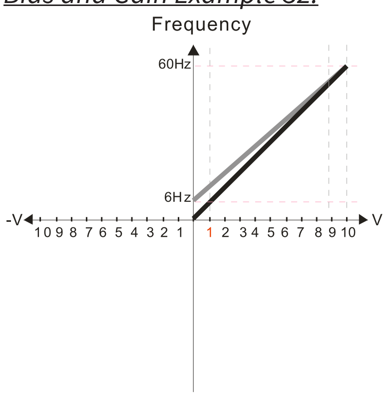
$\frac{60\text{-}6\text{Hz}}{10\text{V}} = \frac{6\text{-}0\text{ Hz}}{(0\text{-XV})}$ $\quad XV = \frac{100}{-9} = -1.11\text{V}$ $\quad \therefore 03.03 = \frac{-1.11}{10} \times 100\%$

$= -11.1\%$

Calculate the gain:

$P03.11 = \frac{10\text{V}}{11.1\text{V}} \times 100\% = 90.0\%$

Bias and Gain Example 32:



P03.07– P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Calculate the bias:

$\frac{60\text{-}6\text{Hz}}{10\text{V}} = \frac{6\text{-}0\text{ Hz}}{(0\text{-XV})}$ $\quad XV = \frac{100}{-9} = -1.11\text{V}$ $\quad \therefore 03.03 = \frac{-1.11}{10} \times 100\%$

$= -11.1\%$

Calculate the gain:

$P03.11 = \frac{10\text{V}}{11.1\text{V}} \times 100\% = 90.0\%$

Analog Input Parameter Example 1: Standard Operation

This example illustrates the default operation of the drive. The example is given to further illustrate the use of the analog calculations. The full range of the analog input signal corresponds to the full forward frequency range of the AC drive.

- *Minimum Frequency Reference = 0Hz*
- *Maximum Frequency Reference = 60Hz*

For AI-V and AI-C: ***P03.50 (Analog Input Curve) must be set to zero (Normal Curve) to enable bias and gain calculations.***

Calculations

A) **Drive Maximum Output Frequency** = P01.00 = (1750 rpm / 1750 rpm) x 60Hz = 60Hz

B) **Analog Bias %** = 0%

Analog Input (AIx)	*AI-V*	*AI-C*
Bias Parameter	P03.03	P03.04

C) **Analog Gain %** = [(60Hz - 0Hz) / 60Hz] x 100 = 100%

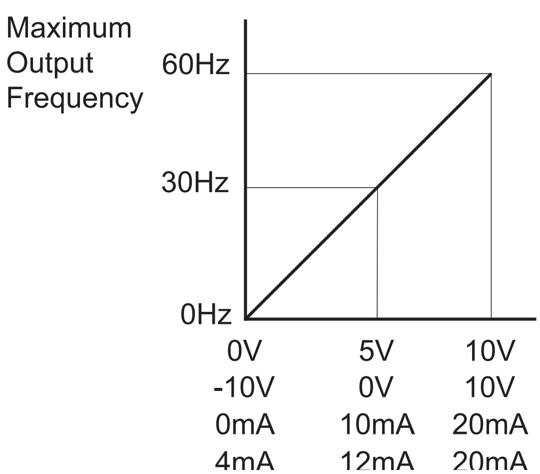
Analog Input	*AI-V*	*AI-C*
Gain Parameter	P03.11	P03.12

D) **Mid-point Frequency** = [(60Hz - 0Hz) / 2] + 0Hz = 30Hz

Parameter Settings

Analog Input	*AI-V or*	*AI-C*	*Parameter Settings*
Bias Parameter	P03.03	P03.04	0.0%
Pos/Neg Bias Parameter	P03.07	P03.08	0: No Bias
Gain Parameter	P03.11	P03.12	100.0%
Reverse Setting Parameter	P03.10		0: No Neg Freq
Curve Parameter	P03.50		0
Drive Max Output Freq	P01.00		60Hz

Results



Analog Input Parameter Example 2: Standard Operation with Increased Maximum Output Frequency

This example illustrates how to run the motor faster than its base speed. For this purpose, the only required parameter change is P01.00, Drive Maximum Output Frequency. (Motors produce reduced output torque when running above their base speed.)

Warning: The Drive Maximum Output Frequency parameter (P01.00) should never exceed the maximum speed rating for the motor you are using. If this information is not readily available, consult your motor manufacturer.

The analog input adjustment parameters can remain defaulted, as determined by the analog input calculations shown below. The increased Drive Maximum Output Frequency can be obtained regardless of whether the Source of Frequency Command (P03.00) is an analog input or one of the other sources, such as the keypad, RS-485 communication interface, jog, or multi-speed settings.

- *Minimum Frequency Reference = 0Hz*
- *Maximum Frequency Reference = 70Hz*
- *Motor Maximum Output Speed = 2042 rpm*

For AI-V and AI-C: ***P03.50 (Analog Input Curve) must be set to zero (Normal Curve) to enable bias and gain calculations.***

Calculations

A) **Drive Maximum Output Frequency** = P01.00 = (2042 rpm / 1750 rpm) x 60Hz = 70Hz

B) **Analog Bias %** = 0%

Analog Input (AIx)	***AI-V***	***AI-C***
Bias Parameter	P03.03	P03.04

C) **Analog Gain %** = [(70Hz – 0Hz) / 70Hz] x 100 = 100% = AIx Input Gain

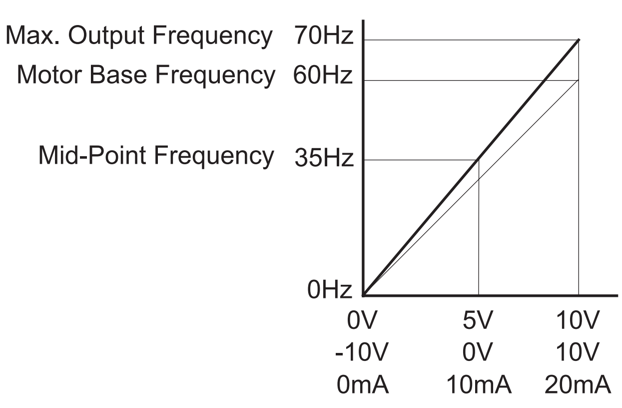
Analog Input	***AI-V***	***AI-C***
Gain Parameter	P03.11	P03.12

D) **Mid-point Frequency** = [(70Hz – 0Hz) / 2] + 0Hz = 35Hz

Parameter Settings

Analog Input	***AI-V or***	***AI-C***	***Parameter Settings***
Bias Parameter	P03.03	P03.04	0.0%
Pos/Neg Bias Parameter	P03.07	P03.08	0: No Bias
Gain Parameter	P03.11	P03.12	100.0%
Reverse Setting Parameter	P03.10		0: No Neg Freq
Curve Parameter	P03.50		0
Drive Max Output Freq	P01.00		70Hz

Results



Analog Input Parameter Example 3: Positive Offset

In this example, the Analog Input will have a positive offset while still using the full scale of the potentiometer or other analog signal device. When the analog signal is at its lowest value (0V, 0mA, or 4mA), the set-point frequency will be at 10Hz. When analog signal is at its maximum value (10V or 20mA), the set-point frequency will be 60Hz. This example will use the three point curve method.

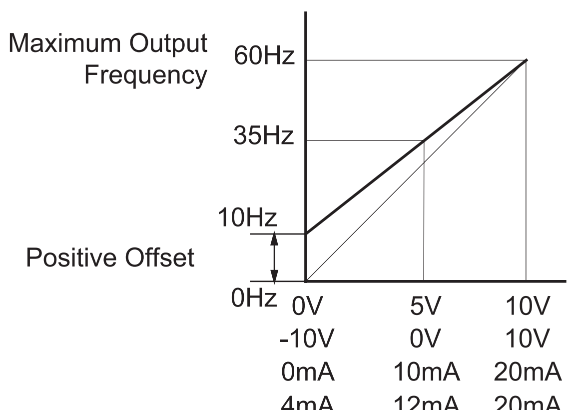
- *Minimum Frequency Reference @0V = 10Hz (10/60=16%)*
- *Mid-point Frequency Reference @5V = 35Hz (35/60=58%)*
- *Maximum Frequency Reference @10V = 60Hz (60/60=100%)*

For AI-V and AI-C: ***P03.50 (Analog Input Curve) must be set to 1 or 2 to enable three point curve calculations.***

Parameter Settings

Analog Input	***AI-V***	***AI-C***	***Parameter Settings***
Polarity	0–10 V	0/4–20 mA	
Curve Selection	P03.50 = 1	P03.50 = 2	1 or 2
Term Input Selection	P03.28=0	P03.28=1,2	0, 1, or 2
Low V/A	P03.63	P03.57	0V or 0/4 mA
Low Hz Percent	P03.64	P03.58	16%
Mid V/A	P03.65	P03.59	5V or 10/12 mA
Mid Hz Percent	P03.66	P03.60	58%
High V/A	P03.67	P03.61	10V or 20mA
High Hz Percent	P03.68	P03.62	100%

Results



Analog Input Parameter Example 4: Forward and Reverse Operation

In this example, the potentiometer (or other analog signal device) is programmed to run a motor full-speed in both forward and reverse directions. The frequency reference will be 0Hz when the potentiometer is positioned at mid-point of its scale. This example will be shown using the three point curve parameters.

Utilize negative frequency percentage values in the proportional settings for reverse motion. Use positive percentage values for forward motion.

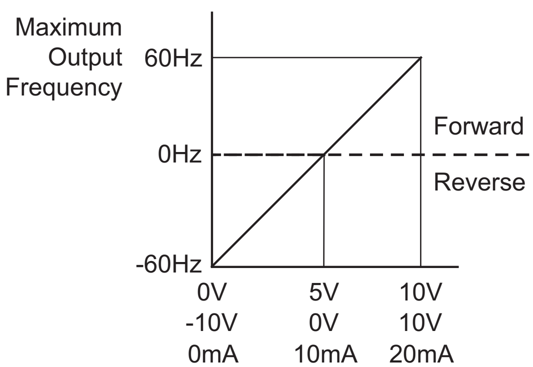
- *Minimum Frequency Reference @0V = -60Hz (-100%)(reverse)*
- *Mid-point Frequency Reference @5V = 0Hz (0%)*
- *Maximum Frequency Reference @10V = 60Hz (100%)*

For AI-V and AI-C: ***P03.50 (Analog Input Curve) must be set to 1 or 2 to enable three point curve parameters.***

Parameter Settings

Analog Input	***AI-V***	***AI-C***	***Parameter Settings***
Polarity	0–10 V	0/4–20 mA	
Curve Selection	P03.50 = 1	P03.50 = 2	1 or 2
Term Input Selection	P03.28=0	P03.28=1,2	0, 1, or 2
Low V/A	P03.63	P03.57	0V or 0/4 mA
Low Hz Percent	P03.64	P03.58	-100%
Mid V/A	P03.65	P03.59	5V or 10/12 mA
Mid Hz Percent	P03.66	P03.60	0%
High V/A	P03.67	P03.61	10V or 20mA
High Hz Percent	P03.68	P03.62	100%

Results



Analog Input Parameter Example 5: Forward Run/Reverse Jog

This example shows an application in which the drive runs full-speed forward and jogs in reverse. The full scale of the potentiometer (or other analog signal device) will be used.

Use negative frequency percentage values in the proportional settings for reverse motion. Use positive percentage values for forward motion.

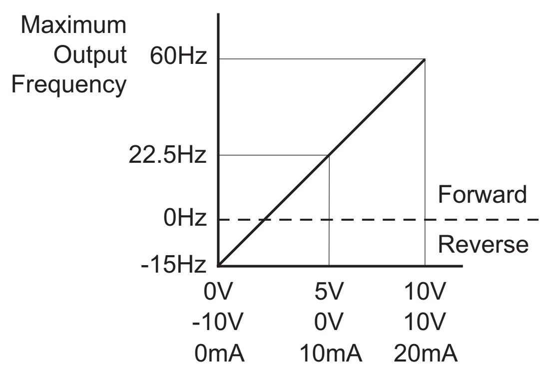
- *Minimum Frequency Reference @0V = -15Hz (-15/60 = -25%)(reverse)*
- *Mid-Point Frequency Reference @5V = 22.5 Hz (22.5/60 = 37.5%)*
- *Maximum Frequency Reference @10V = 60Hz (60/60 = 100%)*

For AI-V and AI-C: ***P03.50 (Analog Input Curve) must be set to 1 or 2 to enable three point curve parameters.***

Parameter Settings

Analog Input	AI-V	AI-C	Parameter Settings
Polarity	0–10 V	0/4–20 mA	
Curve Selection	P03.50 = 1	P03.50 = 2	1 or 2
Term Input Selection	P03.28=0	P03.28=1,2	0, 1, or 2
Low V/A	P03.63	P03.57	0V or 0/4 mA
Low Hz Percent	P03.64	P03.58	-100%
Mid V/A	P03.65	P03.59	5V or 0/4 mA
Mid Hz Percent	P03.66	P03.60	0%
High V/A	P03.67	P03.61	10V or 20mA
High Hz Percent	P03.68	P03.62	100%

Results



Analog Input Parameter Example 6: Reduced Analog Gain

This example shows how to limit the Maximum Frequency Reference by reducing the Analog Input Gain. When the Analog Input is at its maximum value (10V or 20mA), the set-point frequency will be 50Hz. However, this reduced maximum frequency applies only to an Analog Input Source of Frequency Command. The Maximum Output Frequency can still go to 60Hz if controlled from the Keypad, RS-485 interface, Jog Command, or Multi-Speed settings. For this example, the only required parameter change is P03.11 or P03.12, Gain parameter.

- *Minimum Frequency Reference = 0Hz*
- *Maximum Frequency Reference = 50Hz*

For AI-V and AI-C: ***P03.50 (Analog Input Curve) must be set to zero (Normal Curve) to enable bias and gain calculations.***

<u>Calculations</u>

A) **Drive Maximum Output Frequency** = P01.00 = (1750 rpm / 1750 rpm) x 60Hz = 60Hz

B) **Analog Bias %** = 0%

Analog Input (AIx)	*AI-V*	*AI-C*
Bias Parameter	P03.03	P03.04

C) **Analog Gain %** = [(50Hz – 0Hz) / 60Hz] x 100 = 83.3% = AIx Input Gain

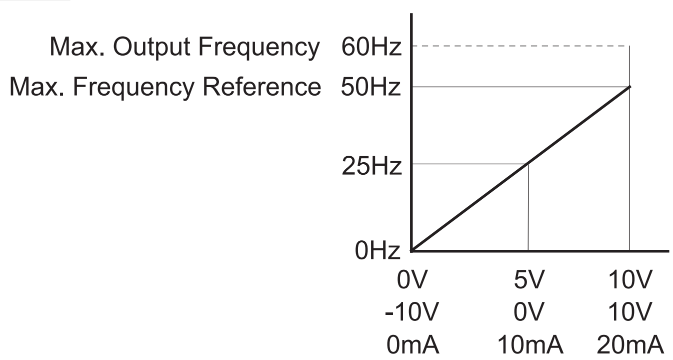
Analog Input	*AI-V*	*AI-C*
Gain Parameter	P03.11	P03.12

D) **Mid-point Frequency** = [(50Hz – 0Hz) / 2] + 0Hz = 25Hz

<u>*Parameter Settings*</u>

Analog Input	*AI-V or*	*AI-C*	*Parameter Settings*
Polarity	Positive (+)	Positive (+)	
Bias Parameter	P03.03	P03.04	0.0%
Pos/Neg Bias Parameter	P03.07	P03.08	0: No Bias
Gain Parameter	P03.11	P03.12	83.3%
Reverse Setting Parameter	P03.10		0: No Neg Freq
Curve Parameter	P03.50		0

<u>*Results*</u>



Analog Input Parameter Example 7: Positive Offset with Reduced Analog Gain

This example illustrates how to provide a positive offset of the Analog Input, while using the full scale of the potentiometer or other analog device. At the same time, the Maximum Frequency Reference is limited by reducing the Analog Input Gain.

When the analog signal is at its lowest value, the set-point frequency will be at 11.5Hz. When the analog signal is at its maximum value, the set-point frequency will be 39.6Hz.

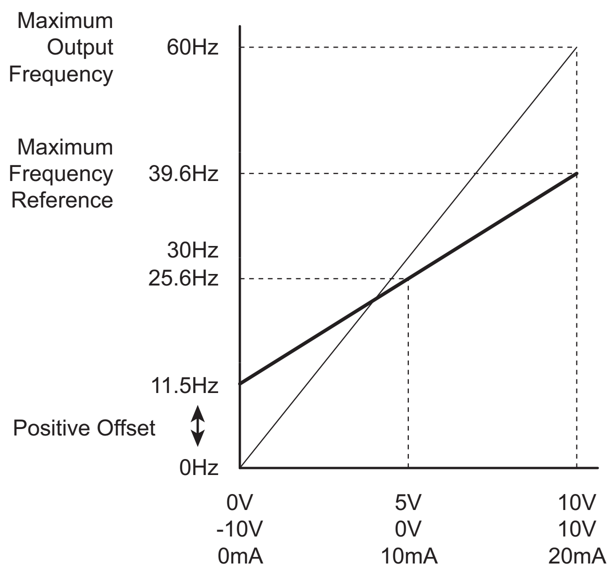
- *Minimum Frequency Reference @0V = 11.5 Hz (11.5/60 = 19%)*
- *Mid-point Frequency Reference @5V = 22.5 Hz (22.5/60 = 37.5%)*
- *Maximum Frequency Reference @10V = 39.6 Hz (39.6/60 = 66%)*

For AI-V and AI-C: ***P03.50 (Analog Input Curve) must be set to 1 or 2 to enable three point curve parameters.***

Parameter Settings

Analog Input	***AI-V***	***AI-C***	***Parameter Settings***
Polarity	0–10 V	0/4–20 mA	
Curve Selection	P03.50 = 1	P03.50 = 2	1 or 2
Term Input Selection	P03.28=0	P03.28=1,2	0, 1, or 2
Low V/A	P03.63	P03.57	0V or 0/4 mA
Low Hz Percent	P03.64	P03.58	-100%
Mid V/A	P03.65	P03.59	5V or 10/12 mA
Mid Hz Percent	P03.66	P03.60	0%
High V/A	P03.67	P03.61	10V or 20mA
High Hz Percent	P03.68	P03.62	100%

Results



Analog Input Parameter Example 8: Trim

This example illustrates trimming the output frequency of the drive.

- *Minimum Frequency Reference = 0Hz*
- *Maximum Frequency Reference = 45Hz*
- *Actual Drive Output Frequency (when P4.08 = 4) = Frequency Command - Trim Reference Frequency*
- *Trim Frequency Reference P4.07 = 15Hz*
  (use comms or keypad to adjust this value based on the application needs)

For AI-V and AI-C: ***P03.50 (Analog Input Curve) must be set to zero (Normal Curve) to enable bias and gain calculations.***

Calculations

A) **Drive Maximum Output Frequency** = P01.00 = (1750 rpm / 1750 rpm) x 60Hz = 60Hz

B) **Analog Bias %** = 25%

Analog Input (AIx)	*AI-V*	*AI-C*
Bias Parameter	P03.03	P03.04

C) **Analog Gain %** = [(60Hz - 0Hz) / 60Hz] x 100 = 100%

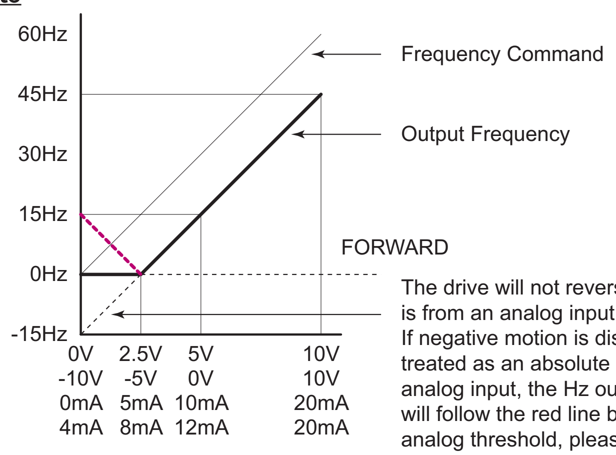
Analog Input	*AI-V*	*AI-C*
Polarity	Positive (+)	Positive (+)
Gain Parameter	P03.11	P03.12

D) **Mid-point Frequency** = [(45Hz – 0Hz) / 2] + 0Hz = 22.5 Hz

Parameter Settings

Analog Input	*AI-V or*	*AI-C*	*Parameter Settings*
Polarity	Positive (+)	Positive (+)	
Bias Parameter	P03.03	P03.04	25%
Pos/Neg Bias Parameter	P03.07	P03.08	3: ABS of Bias
Gain Parameter	P03.11	P03.12	100.0%
Reverse Setting Parameter	P03.10		1: Neg Freq Allowed
Curve Parameter	P03.50		0

Results



The drive will not reverse direction unless the Frequency Command is from an analog input, and reverse motion is enabled in P03.10. If negative motion is disabled (P03.10=0), the analog signal will be treated as an absolute value. Instead of 0Hz output below 2.5V analog input, the Hz output will be treated as an absolute value and will follow the red line below 2.5V. To establish 0Hz below a specific analog threshold, please see Analog Input Parameter Example 9.

Analog Input Parameter Example 9: Zero Volts Out at Low V_{IN}

This example gives 0Hz output through the first 0V~2.5V of Analog Input. The rest of the 2.5V~10V corresponds to 0~45 Hz. This example will use the three point curve method.

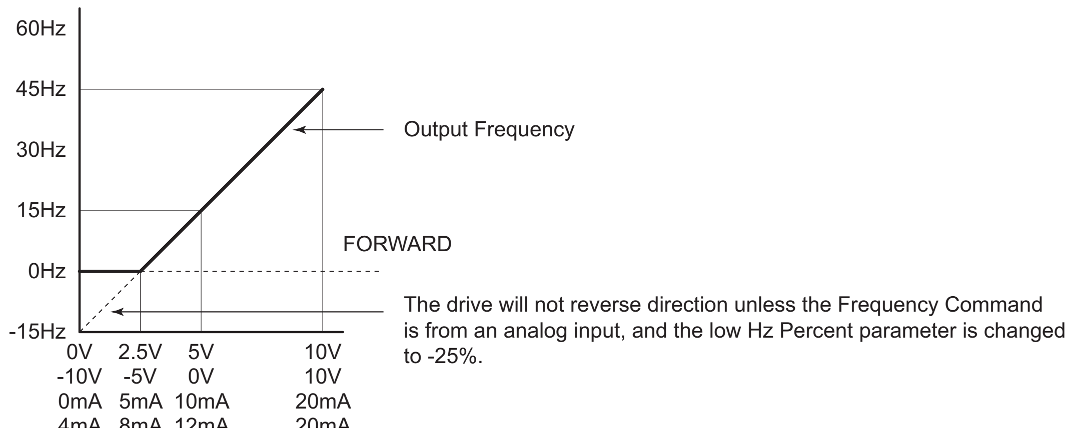
- *Minimum Frequency Reference @0V = 0Hz (0/60 = 0%)*
- *Mid-point Frequency Reference @5V = 0Hz (0/60 = 0%)*
- *Maximum Frequency Reference @10V = 45Hz (45/60 = 75%)*

For AI-V and AI-C: ***P03.50 (Analog Input Curve) must be set to 1 or 2 to enable three point curve parameters.***

Parameter Settings

Analog Input	AI-V	AI-C	Parameter Settings
Polarity	0–10 V	0/4–20 mA	
Curve Selection	P03.50 = 1	P03.50 = 2	1 or 2
Term Input Selection	P03.28=0	P03.28=1,2	0, 1, or 2
Low V/A Input	P03.63	P03.57	0V or 0/4 mA
Low Hz Percent	P03.64	P03.58	0%
Mid V/A Input	P03.65	P03.59	2.5V or 5/8 mA
Mid Hz Percent	P03.66	P03.60	0%
High V/A Input	P03.67	P03.61	10V or 20mA
High Hz Percent	P03.68	P03.62	75%

Results



Analog Input Parameter Example 10: Inverse Analog Speed Reference

This example illustrates the use of an inverse analog speed reference to the drive. The minimum analog reference value corresponds to the full forward output frequency of the drive. In this example, only the Pos/Neg Bias Parameter must be changed from default.

- *Minimum Frequency Reference = 60Hz*
  (drive output frequency at the minimum analog input reference, 0V)
- *Maximum Frequency Reference = 0Hz*
  (drive output frequency at the maximum analog input reference, 10V)

*For AI-V and AI-C: **P03.50 (Analog Input Curve) must be set to zero (Normal Curve) to enable bias and gain calculations.***

Calculations (see page 4–105 for formulas)

A) **Drive Maximum Output Frequency** = P01.00 = (1750 rpm / 1750 rpm) x 60Hz = 60Hz

B) **Analog Bias %** = 100%

Analog Input (AIx)	*AI-V*	*AI-C*
Bias Parameter	P03.03	P03.04

C) **Analog Gain %** = [(0Hz - 60Hz) / 60Hz] x 100 = -100%

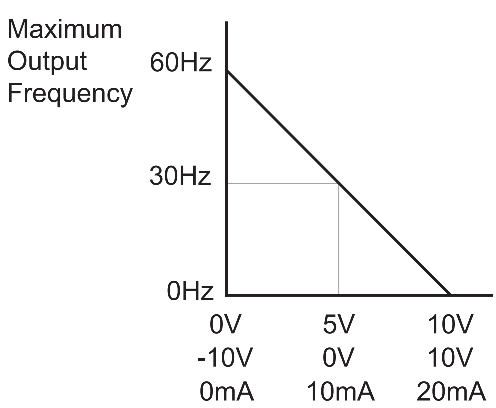
Analog Input	*AI-V*	*AI-C*
Gain Parameter	P03.11	P03.12

D) **Mid-point Frequency** = [(60Hz - 0Hz) / 2] + 0Hz = 30Hz

Parameter Settings

Analog Input	*AI-V or*	*AI-C or*	*Parameter Settings*
Polarity	Positive (+)	Positive (+)	
Bias Parameter	P03.03	P03.04	100.0%
Pos/Neg Bias Parameter	P03.07	P03.08	2: Greater than or equal to
Gain Parameter	P03.11	P03.12	100.0%
Reverse Setting Parameter	P03.10		0: No Neg Freq
Curve Parameter	P03.50		0
Drive Max Output Freq	P01.00		60Hz

Results



Group P04.xx Details – Multi-Step Speed Parameters

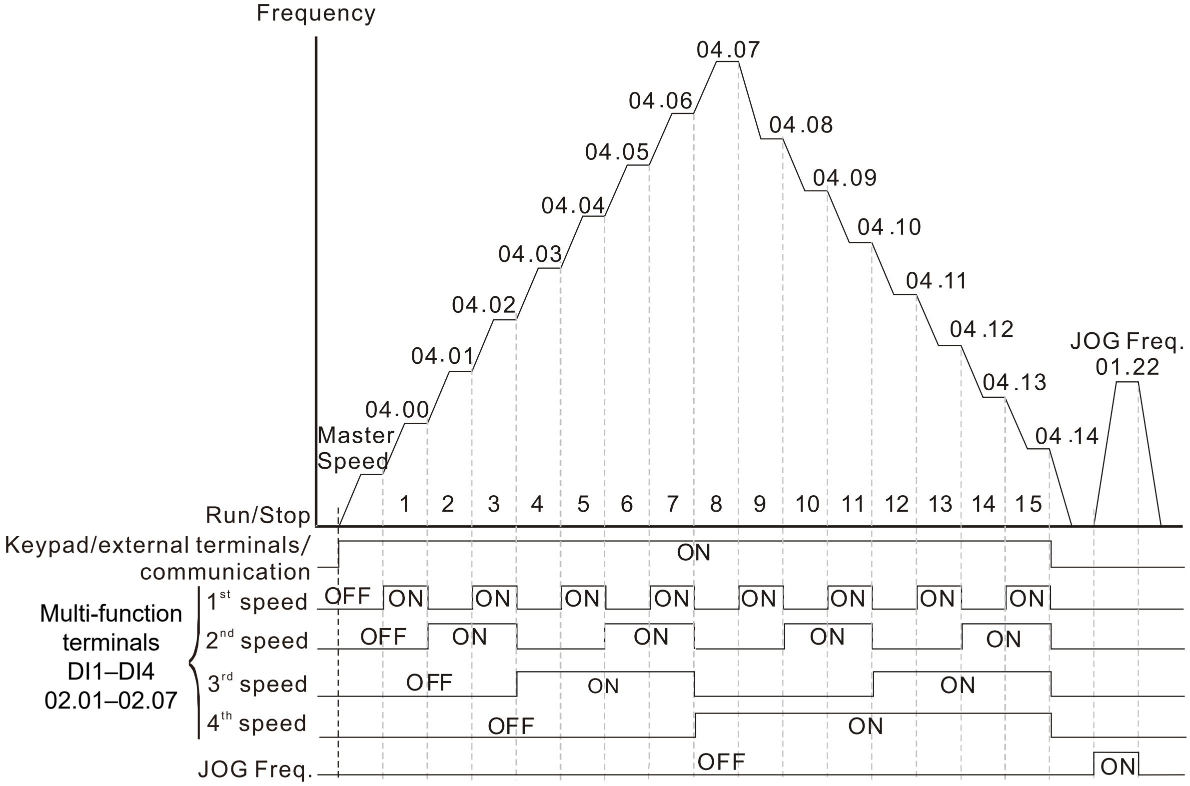
		Type	Hex Addr	Dec Addr
P04.00	***1st Step Speed Frequency***	♦R/W	0400	41025
P04.01	***2nd Step Speed Frequency***	♦R/W	0401	41026
P04.02	***3rd Step Speed Frequency***	♦R/W	0402	41027
P04.03	***4th Step Speed Frequency***	♦R/W	0403	41028
P04.04	***5th Step Speed Frequency***	♦R/W	0404	41029
P04.05	***6th Step Speed Frequency***	♦R/W	0405	41030
P04.06	***7th Step Speed Frequency***	♦R/W	0406	41031
P04.07	***8th Step Speed Frequency***	♦R/W	0407	41032
P04.08	***9th Step Speed Frequency***	♦R/W	0408	41033
P04.09	***10th Step Speed Frequency***	♦R/W	0409	41034
P04.10	***11th Step Speed Frequency***	♦R/W	040A	41035
P04.11	***12th Step Speed Frequency***	♦R/W	040B	41036
P04.12	***13th Step Speed Frequency***	♦R/W	040C	41037
P04.13	***14th Step Speed Frequency***	♦R/W	040D	41038
P04.14	***15th Step Speed Frequency***	♦R/W	040E	41039
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.0 Hz	0.00		

Use the multi-function input terminals (refer to settings 1–4 of P02.01–P02.05 Multi-function Input Command) to select the multi-step speed command (the maximum is 15th step speed). P04.00 to P04.14 sets the multi-step speed (frequency) as shown in the following diagram.

- *The external terminal/digital keypad/communication controls the RUN and STOP commands with P00.21.*
- *You can set each multi-step speed between 0.00–599.0 Hz during operation.*
- *Explanation for the timing diagram of the multi-step speed and external terminals.*
  The related parameter settings are:
  a) P04.00–P04.14: sets the 1st–15th multi-step speed (to set the frequency of each step speed).
  b) P02.01–P02.05: sets the multi-function input terminals (multi-step speed command 1–4).

Related parameters:

- *P01.22 JOG frequency setting*
- *P02.01 multi-function input command 1 (DI1)*
- *P02.02 multi-function input command 2 (DI2)*
- *P02.03 multi-function input command 3 (DI3)*
- *P02.04 multi-function input command 4 (DI4)*
- *P02.05 multi-function input command 5 (DI5)*



Speed Selection through External Terminals

Group P05.xx Details – Motor Parameters

In this parameter group, the following are abbreviations for different types of motors:

- *IM: Induction motor*
- *PM: Permanent magnet synchronous AC motor*
- *IPM: Interior permanent magnet synchronous AC motor*
- *SPM: Surface permanent magnet synchronous AC motor*

		Type	Hex Addr	Dec Addr
P05.00	**Motor Parameter Auto-tuning**	R/W	0000	41281
	Range/Units (Format: 16-bit binary)	Default		
	0: No function 1: Rotary Tuning for IM motor 2: Static test for induction motor (IM) 5: PM rotary tuning 13: Static Auto-tuning for PM (IPM/SPM)	0		

Drive motion will occur during these tests. After setting this parameter, press Run on the drive to start the tuning process.

When auto tuning is in process, "TUN" will display on the drive keypad.

For PM motors, tune motor with no load connected. P05.00=5 provides more accurate calculation of the Ke parameter (P05.43) based on actual motor rotation. When P05.00=13, the Ke parameter is calculated based on the motor power, current and rotor speed.

See Adjustment and Applications section for detailed tuning procedures.

		Type	Hex Addr	Dec Addr
P05.01	**Full-load Current for Induction Motor 1 (A)**	Read	0501	41282
	Range/Units (Format: 16-bit unsigned)	Default		
	10–120 % of the drive's rated current	Model dependent		

Sets this value according to the rated current of the motor as indicated on the motor nameplate. The default is 90% of the drive's rated current.

Example:

The rated current for a 7.5 hp (5.5 kW) motor is 25A. The default is 22.5 A.

The setting range is 2.5–30 A (25 × 10% = 2.5 A and 25 × 120% = 30A).

		Type	Hex Addr	Dec Addr
P05.02	**Rated Power for Induction Motor 1 (kW)**	♦R/W	0502	41283
	Range/Units (Format: 16-bit unsigned)	Default		
	0.00–655.35 kW	Model dependent		

P05.02 sets the rated power for motor 1. The default is the drive's power value.

		Type	Hex Addr	Dec Addr
P05.03	**Rated Speed for Induction Motor 1 (rpm)**	♦R/W	0503	41284
	Range/Units (Format: 16-bit unsigned)	Default		
	0–xxxxx rpm (Depending on the motor's number of poles) 1710 (60Hz 4 poles); 1410 (50Hz 4 poles)	Dependent on the motor's number of poles		

P05.03 sets the rated speed for the motor as indicated on the motor nameplate.

This parameter works in conjunction with the Number of Poles and Hertz. Set up P01.01 and P05.04 before setting up P05.03 to ensure that the motor operates normally.

		Type	Hex Addr	Dec Addr
P05.04	***Number of Poles for Induction Motor 1***	R/W	0504	41285
	Range/Units (Format: 16-bit unsigned)	*Default*		
	2–20	4		

P05.04 sets the number of poles for the motor (must be an even number).
Check P05.03 for accuracy after changing this value.

		Type	Hex Addr	Dec Addr
P05.05	***No-load Current for Induction Motor 1 (A)***	R/W	0505	41286
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–P05.01 default	Model dependent		

The default is 40% of the motor's rated current.

		Type	Hex Addr	Dec Addr
P05.06	***Stator Resistance (Rs) for Induction Motor 1***	R/W	0506	41287
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.000–65.535 Ω	Model dependent		

		Type	Hex Addr	Dec Addr
P05.07	***Rotor Resistance (Rr) for Induction Motor 1***	R/W	0507	41288
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.000–65.535 Ω	0.000		

		Type	Hex Addr	Dec Addr
P05.08	***Magnetizing Inductance (Lm) for Induction Motor 1***	R/W	0508	41289
P05.09	***Stator Inductance (Lx) for Induction Motor 1***	R/W	0509	41290
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–6553.5 mH	0.0		

		Type	Hex Addr	Dec Addr
P05.13	***Full-load Current for Induction Motor 2 (A)***	R/W	050D	41294
	Range/Units (Format: 16-bit unsigned)	*Default*		
	10–120 % of the drive's rated current	Model dependent		

Set P05.13 according to the rated current of the motor as indicated on the motor nameplate. The default is 90% of the drive's rated current.
Example:
The rated current for a 7.5 hp (5.5 kW) motor is 25A. The default is 22.5 A.
The setting range is 2.5–30 A (25 × 10 % = 2.5 A and 25 × 120 % = 30A).

		Type	Hex Addr	Dec Addr
P05.14	***Rated Power for Induction Motor 2 (kW)***	♦R/W	050E	41295
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–655.35 kW	Model dependent		

P05.14 sets the rated power for motor 2. The default is the drive's power value.

		Type	*Hex Addr*	*Dec Addr*
P05.15	***Rated Speed for Induction Motor 2 (rpm)***	♦R/W	050F	41296
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–xxxxx rpm (Depending on the motor's number of poles) 1710 (60Hz 4 poles); 1410 (50Hz 4 poles)	Dependent on the motor's number of poles		

P05.15 sets the rated speed for the motor as indicated on the motor nameplate.

This parameter works in conjunction with the Number of Poles and Hertz. Set up P01.35 and P05.16 before setting up P05.15 to ensure that the motor operates normally.

		Type	*Hex Addr*	*Dec Addr*
P05.16	***Number of Poles for Induction Motor 2***	R/W	0510	41297
	Range/Units (Format: 16-bit unsigned)	*Default*		
	2–20	4		

P05.16 sets the number of poles for the motor (must be an even number).

Check P05.15 for accuracy after changing this value.

		Type	*Hex Addr*	*Dec Addr*
P05.17	***No-load Current for Induction Motor 2 (A)***	R/W	0511	41298
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–P05.13 default	Model dependent		

The default is 40% of the motor's rated current.

		Type	*Hex Addr*	*Dec Addr*
P05.18	***Stator Resistance (Rs) for Induction Motor 2***	R/W	0512	41299
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.000–65.535 Ω	Model dependent		

		Type	*Hex Addr*	*Dec Addr*
P05.19	***Rotor Resistance (Rr) for Induction Motor 2***	R/W	0513	41300
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.000–65.535 Ω	0.000		

		Type	*Hex Addr*	*Dec Addr*
P05.20	***Magnetizing Inductance (Lm) for Induction Motor 2***	R/W	0514	41301
P05.21	***Stator Inductance (Lx) for Induction Motor 2***	R/W	0515	41302
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–6553.5 mH	0.0		

		Type	*Hex Addr*	*Dec Addr*
P05.22	***Multi-motor (Induction) Selection***	R/W	0516	41303
	Range/Units (Format: 16-bit binary)	*Default*		
	1: Motor 1 2: Motor 2	1		

P05.22 sets the motor operated by the AC motor drive. Multi-motor selection only supports single control mode. For example, when you set motor 1 as SVC control mode, the control mode of motor 2 is also set as SVC

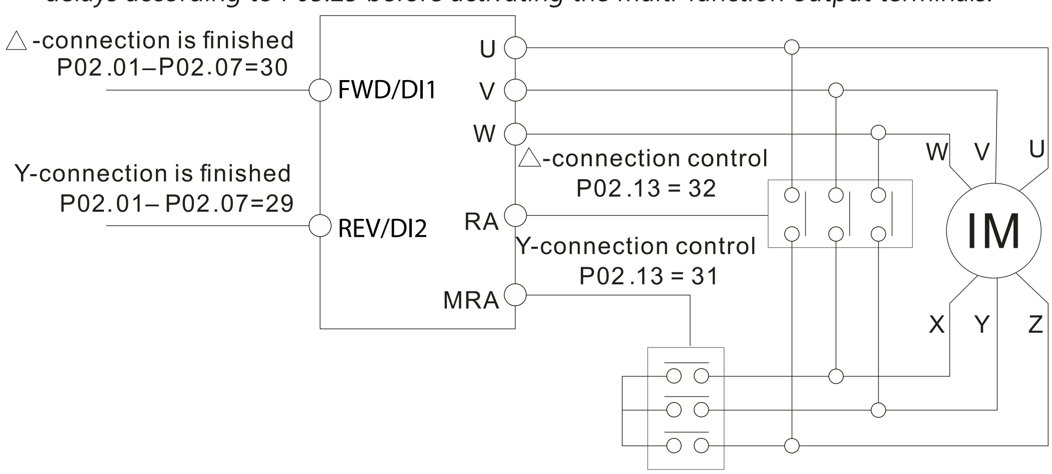
		Type	Hex Addr	Dec Addr
P05.23	***Frequency for Y-connection /Δ-connection Switch for an Induction Motor***	♦R/W	0517	41304
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.0 Hz	60.00		

		Type	Hex Addr	Dec Addr
P05.24	***Y-connection /Δ-connection Switch for an Induction Motor***	R/W	0518	41305
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable 1: Enable	0		

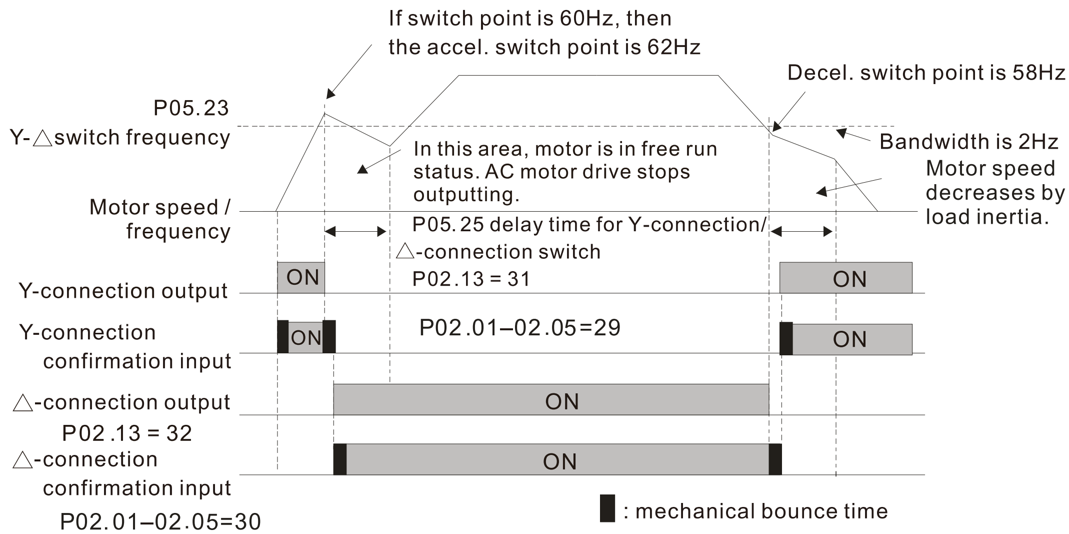
		Type	Hex Addr	Dec Addr
P05.25	***Delay Time for Y-connection/Δ-connection Switch for an Induction Motor***	♦R/W	0519	41306
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.000–60.000 sec.	0.200		

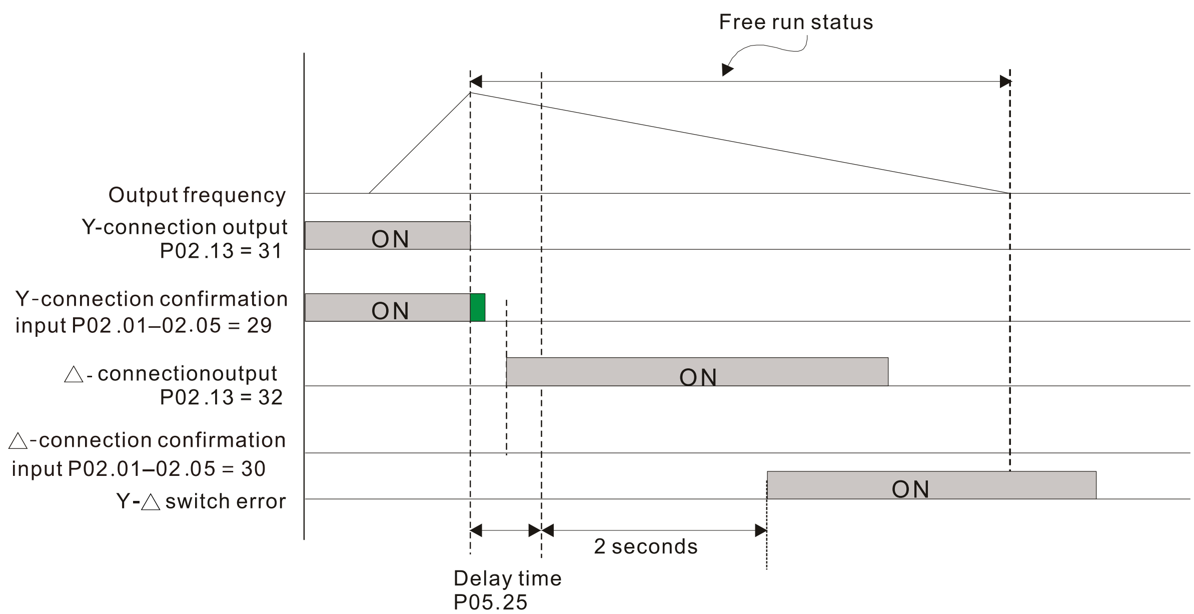
You can apply P05.23–P05.25 in wide range motors, and the motor coil executes the Y-connection/Δ-connection switch as required. The wide range motors are related to the motor design. In general, the motor has higher torque with low speed Y-connection and has higher speed with high speed Δ-connection.

- *P05.24 enables and disables the switch of Y-connection/Δ-connection.*
- *When you set P05.24 to 1, the drive uses the P05.23 setting and current motor frequency, and switches the current motor to Y-connection or Δ-connection. You can switch the relevant motor parameter settings simultaneously.*
- *P05.25 sets the switch delay time of Y-connection/Δ-connection.*
- *When the output frequency reaches the Y-connection/Δ-connection switch frequency, the drive delays according to P05.25 before activating the multi-function output terminals.*



Y- △connection switch: can be used for wide range motor
Y -connection for low speed: higher torque can be used for rigid tapping
△-connection for high speed: higher speed can be used for high-speed drilling





		Type	Hex Addr	Dec Addr
P05.26	***Accumulated Watt-second for a Motor in Low Word (W-msec.)***	Read	051A	41307
P05.27	***Accumulated Watt-second for a Motor in High Word (W-sec. or joule)***	Read	051B	41308
P05.28	***Accumulated Watt-hour for a Motor (W-hour)***	Read	051C	41309
P05.29	***Accumulated Watt-hour for a Motor in Low Word (kW-hour)***	Read	051D	41310
P05.30	***Accumulated Watt-hour for a Motor in High Word (MW-hour)***	Read	051E	41311
	Range/Units (Format: 16-bit unsigned)	*Default*		
	Read only	0		

Parameters P05.26–P05.30 record the amount of power the motors consume. The accumulation begins when the drive is activated and the record is saved when the drive stops or turns OFF. The amount of consumed watts continues to accumulate when the drive is activated again. To clear the accumulation, set P00.02 to 5 to return the accumulation record to 0.

- *The accumulated total watts of the motor per second = P05.27 x 65536 + P05.26.*
  Example: When P05.26 = 2548.1 and P05.27 = 15.2, the accumulated total watts of the motor per second = 15.2 x 65536 + 2548.1 = 996147.2 + 2548.1 = 998695.3
- *The accumulated total kilowatts of the motor per hour = P05.30 x 65536 + P05.29.*
  Example: When P05.29 = 3361.4 and P05.30 = 11.2, the accumulated total kilowatts of the motor per hour = 11.2 x 65536 + 3361.4 = 734003.2 + 3361.4 = 737364.6

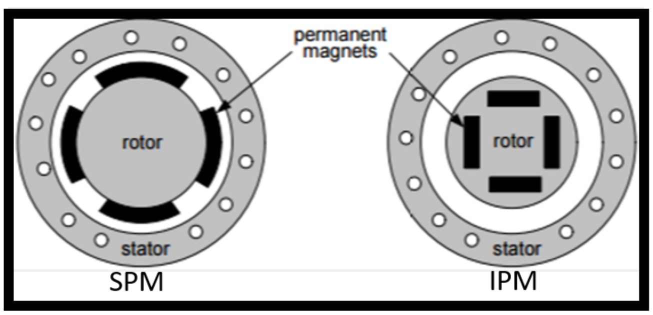
		Type	Hex Addr	Dec Addr
P05.31	***Accumulated Motor Operation Time (minutes)***	R/W	051F	41312
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–1439	0		

		Type	Hex Addr	Dec Addr
P05.32	***Accumulated Motor Operation Time (days)***	R/W	0520	41313
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–65535	0		

Use P05.31 and P05.32 to record the motor operation time. To clear the operation time, set P05.31 and P05.32 to 0. An operation time shorter than 60 seconds is not recorded.

		Type	Hex Addr	Dec Addr
P05.33	***Induction Motor (IM) or Permanent Magnet Synchronous AC Motor Selection***	R/W	0521	41314
	Range/Units (Format: 16-bit binary)	*Default*		
	0: IM (Induction motor) 1: SPM (Surface permanent magnet synchronous AC motor) 2: IPM (Interior permanent magnet synchronous AC motor)	0		

On SPM motors, magnets are mounted on the exterior of the rotor shaft. On IPM motors, magnets are mounted inside of the rotor shaft.



		Type	Hex Addr	Dec Addr
P05.34	***Full-load Current for a Permanent Magnet Synchronous AC Motor***	R/W	0522	41315
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–120% of the drive's rated current	Model dependent		

		Type	Hex Addr	Dec Addr
P05.35	***Rated Power for a Permanent Magnet Synchronous AC Motor***	R/W	0523	41316
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–655.35 kW	Model dependent		

Sets the rated power for the permanent magnet synchronous AC motor. The default is the drive's power value.

		Type	Hex Addr	Dec Addr
P05.36	***Rated Speed for a Permanent Magnet Synchronous AC Motor***	R/W	0524	41317
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–65535 rpm	2000		

		Type	Hex Addr	Dec Addr
P05.37	***Number of Poles for a Permanent Magnet Synchronous AC Motor***	R/W	0525	41318
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–65535	10		

		Type	Hex Addr	Dec Addr
P05.39	***Stator Resistance for a Permanent Magnet Synchronous AC Motor***	R/W	0527	41320
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.000–65.535 Ω	0.000		

		Type	Hex Addr	Dec Addr
P05.40	***Permanent Magnet Synchronous AC Motor Ld***	R/W	0528	41321
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–655.35 mH	0.00		

		Type	Hex Addr	Dec Addr
P05.41	***Permanent Magnet Synchronous AC Motor Lq***	R/W	0529	41322
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–655.35 mH	0.00		

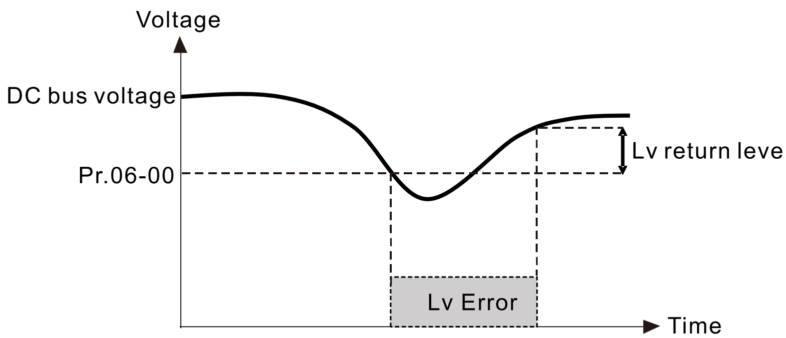
		Type	Hex Addr	Dec Addr
P05.43	***Ke parameter of a Permanent Magnet Synchronous AC Motor***	R/W	052B	41324
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–65535 V / krpm	0		

Group P06.xx Details – Protection Parameters

		Type	Hex Addr	Dec Addr
P06.00	**Low Voltage Level**	♦R/W	0600	41537
	Range/Units (Format: 16-bit unsigned)	Default		
	120V / 230V series: 150.0–220.0 VDC	180.0		
	460V series: 300.0–440.0 VDC	360.0		

P06.00 sets the Low Voltage (LV) level. When the DC bus voltage is lower than P06.00 an LV fault is triggered.

- *If the LV fault is triggered during operation, the drive stops output and the motor coasts to a stop. There are three LV faults, LvA (LV during acceleration), Lvd (LV during deceleration), and Lvn (LV in constant speed) that are triggered according to the status of acceleration or deceleration. You must press RESET to clear the LV fault. The drive automatically restarts if set to restart after momentary power loss (refer to P07.06 Restart after Momentary Power Loss and P07.07 Allowed Power Loss Duration for details).*
- *If the LV fault is triggered when the drive is in STOP status, the drive displays LvS (LV during stop), which is not recorded, and the drive restarts automatically when the input voltage is higher than the LV level +30V (120V/230V series), +60V (460V series).*



		Type	Hex Addr	Dec Addr
P06.01	**Over-voltage Stall Prevention**	♦R/W	0601	41538
	Range/Units (Format: 16-bit unsigned)	Default		
	0: Disabled			
	120V / 230V: 0.0–390.0 VDC	380.0		
	460V: 0.0–900.0 VDC	760.0		

- *Set P06.01 to 0.0 to disable the over-voltage stall prevention function (connected with braking unit or braking resistor). Use this setting when braking units or braking resistors are connected to the drive.*
- *Set P06.01 to a value > 0.0 to enable the over-voltage stall prevention. This setting refers to the power supply system and loading. If the setting is too low, then over-voltage stall prevention is easily activated, which may increase deceleration time.*
- *When setting value exceeds the OV level (as shown on the table below), the OV stall function is disabled.*

Voltage	OV Stall	OV	Setting Range
230V	380VDC	410VDC	0–450 VDC
460V	760VDC	820VDC	0–900 VDC

Related parameters:

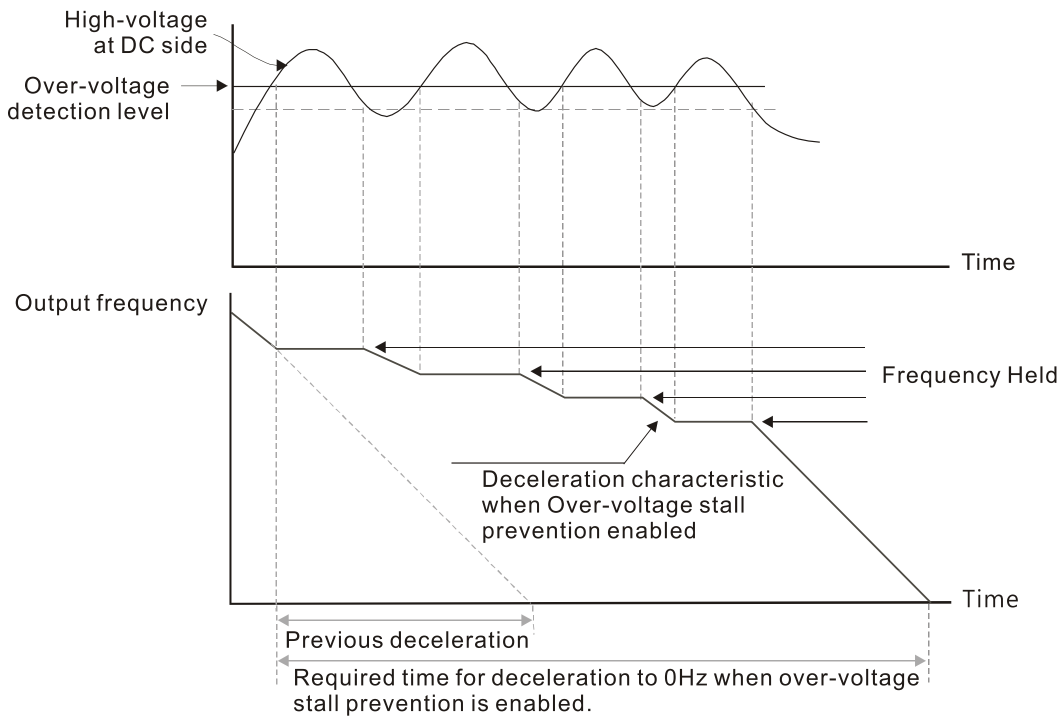
P01.13, P01.15, P01.17, P01.19 Deceleration Time 1–4, P02.13 Multi-function Output 1 (R1), P02.16 Multi-function Output (DO1), and P06.02 Selection for Over-voltage Stall Prevention.

		Type	Hex Addr	Dec Addr
P06.02	***Selection for Over-voltage Stall Prevention***	♦R/W	0602	41539
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Traditional over-voltage stall prevention	0		
	1: Smart over-voltage stall prevention			

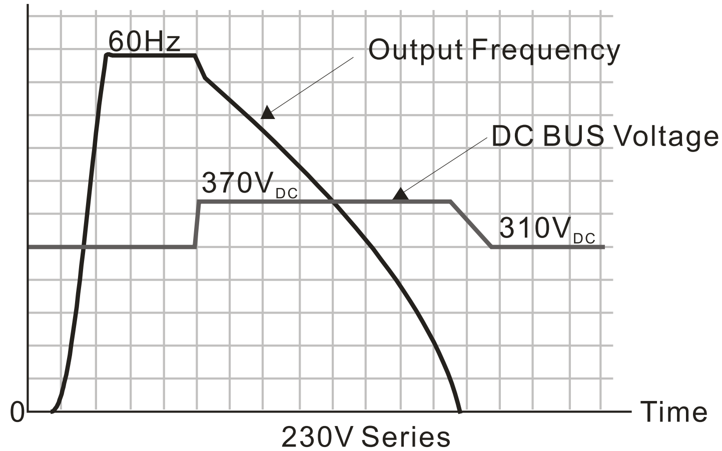
Use this function when you are unsure about the load inertia. When stopping under normal load, the over-voltage does not occur during deceleration and meet the deceleration time setting.

If an over-voltage occurs during deceleration to STOP due to a regenerative inertial load increase, then the AC motor drive extends the deceleration time automatically until the drive stops.

When P06.02 is set to 0, and during deceleration the motor exceeds the synchronous speed due to high load inertia (the motor becomes an electrical generator), then the DC bus voltage may exceed its maximum allowable value due to motor regeneration, or drive deceleration time being set too short. When traditional over-voltage stall prevention is enabled, if the DC bus voltage detected is too high, then the drive stops deceleration until the DC bus voltage drops below the setting value.



When P06.02 is set to 1 (smart over-voltage stall prevention), during deceleration the drive maintains the DC bus voltage preventing drive OV.



When you enable the over-voltage stall prevention, the drive's deceleration time is longer than the setting. If you encounter any problem with the deceleration time, refer to the following guides for troubleshooting.

1) Increase the deceleration time to a proper value.
2) Install a braking resistor (refer to Accessories appendix for details) to dissipate the electrical energy that is generated from the motor.

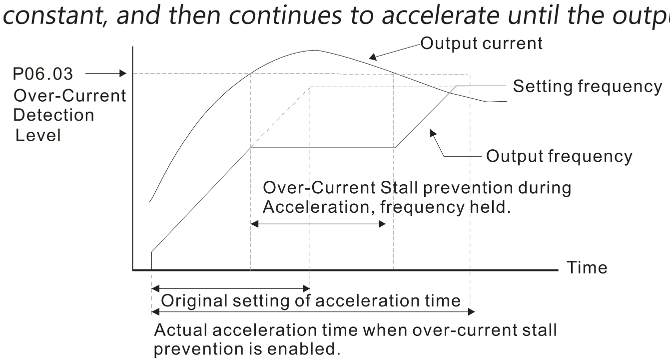
Related parameters:

P01.13, P01.15, P01.17, P01.19 Deceleration Time 1–4, P02.13 Multi-function Output 1 (Relay 1), P02.16 Multi-function Output (DO1), and P06.01 Over-voltage Stall Prevention.

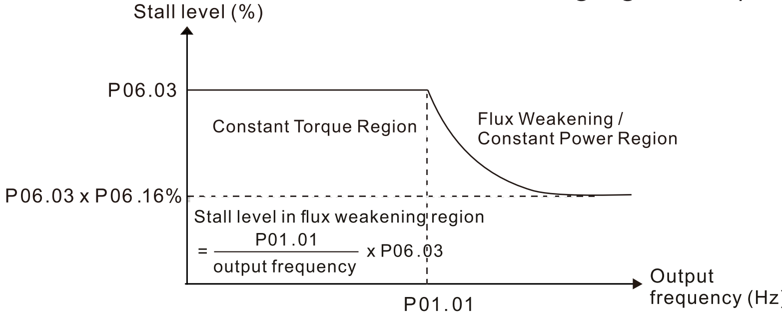
		Type	*Hex Addr*	*Dec Addr*
P06.03	***Over-current Stall Prevention during Acceleration***	♦R/W	0603	41540
Range/Units (Format: 16-bit unsigned)		*Default*		
	Variable Torque (VT): 0–150% (100% corresponds to the rated current of the drive)	120		
	Constant Torque (CT): 0–200% (100% corresponds to the rated current of the drive)	180		

In constant torque mode (P00.16=1), if the DC voltage is higher than 700VDC (460V series) or 350VDC (120/230 series), the maximum value for P06.03 is 185%.

- *If the motor load is too large or the drive's acceleration time is too short, the output current of the drive may be too high during acceleration, and it may cause motor damage or trigger the drive's protection functions (OL or OC). Use this parameter to prevent these situations.*
- *During acceleration, the output current of the drive may increase abruptly and exceed the setting value of P06.03. In this case, the drive stops accelerating and keeps the output frequency constant, and then continues to accelerate until the output current decreases.*



- *Refer to P06.16 for the stall level in flux weakening region. The protection curve is:*



- *When you enable the over-current stall prevention, the drive's acceleration time is longer than the setting.*
- *When the over-current stall prevention occurs because the motor capacity is too small or operates in the default, decrease the P06.03 setting value.*
- *If you encounter any problem with the acceleration time, refer to the following guides for troubleshooting.*
  a) Increase the deceleration time to a proper value.
  b) Set P01.44 Auto-Acceleration and Auto-Deceleration Setting to 1, 3 or 4 (auto-acceleration)

Related parameters:

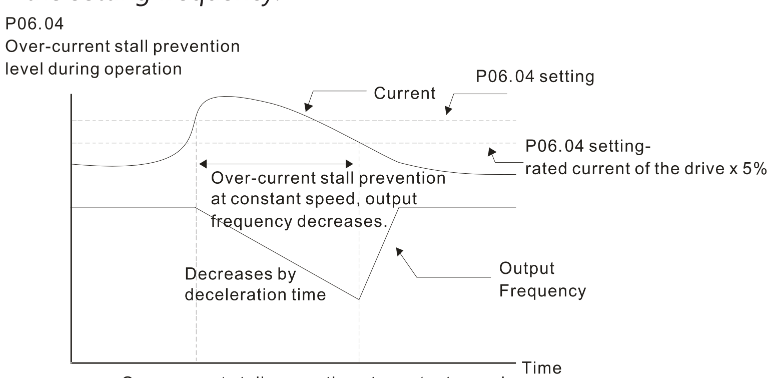
P01.12, P01.14, P01.16, P01.18 (Acceleration Time 1–4), P01.44. Auto-Acceleration and Auto-Deceleration Setting, P02.13 Multi-function Output 1 (Relay 1), P02.16–P02.17 Multi-function Output (DO1, DO2).

		Type	Hex Addr	Dec Addr
P06.04	***Over-current Stall Prevention during Operation***	♦R/W	0604	41541
	Range/Units (Format: 16-bit unsigned)	*Default*		
	Variable Torque (VT): 0–150% (100% corresponds to the rated current of the drive)	120		
	Constant Torque (CT): 0–200% (100% corresponds to the rated current of the drive)	180		

This is a protection for the drive to decrease output frequency automatically when the motor overloads abruptly during constant motor operation.

In constant torque mode (P00.16=1), if the DC voltage is higher than 700VDC (460V series) or 350VDC (120/230 series), the maximum value for P06.04 is 185%.

- *This is a protection for the drive and decreases output frequency automatically when the motor overloads abruptly during constant motor operation.*
- *If the output current exceeds the setting value for P06.04 when the drive is operating, the drive decelerates according to the P06.05 setting to prevent the motor from stalling. If the output current is lower than the setting value for P06.04, the drive accelerates (according to P06.05) to the setting frequency.*



Over-current stall prevention at constant speed

		Type	Hex Addr	Dec Addr
P06.05	***Acceleration/Deceleration Time Selection for Stall Prevention at Constant Speed***	♦R/W	0605	41542

Range/Units (Format: 16-bit binary) — *Default*: 0

0: By current acceleration / deceleration time
1: By the first acceleration / deceleration time
2: By the second acceleration / deceleration time
3: By the third acceleration / deceleration time
4: By the fourth acceleration / deceleration time
5: By auto-acceleration / auto-deceleration

P06.05 sets the acceleration / deceleration time selection when stall prevention occurs at constant speed.

		Type	Hex Addr	Dec Addr
P06.06	***Over-torque Detection Selection (Motor 1)***	♦R/W	0606	41543
P06.09	***Over-torque Detection Selection (Motor 2)***	♦R/W	0609	41546

Range/Units (Format: 16-bit binary) — *Default*: 0

0: No function
1: Continue operation after over-torque detection during constant speed operation
2: Stop after over-torque detection during constant speed operation
3: Continue operation after over-torque detection during RUN
4: Stop after over-torque detection during RUN

When you set P06.06 and P06.09 to 1 or 3, a warning message displays but there is no error record.
When you set P06.06 and P06.09 to 2 or 4, an error message displays and there is an error record.

		Type	Hex Addr	Dec Addr
P06.07	***Over-torque Detection Level (Motor 1)***	♦R/W	0607	41544
P06.10	***Over-torque Detection Level (Motor 2)***	♦R/W	060A	41547

Range/Units (Format: 16-bit unsigned) — *Default*: 120

10–250% (100% corresponds to the rated current of the drive)

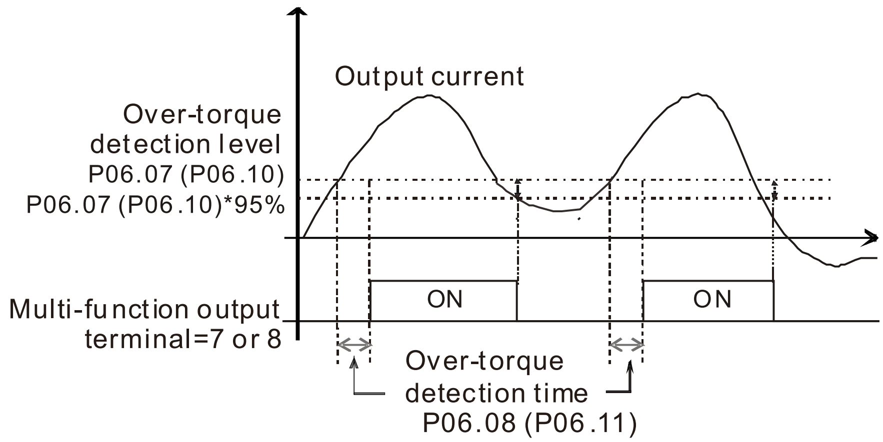
		Type	Hex Addr	Dec Addr
P06.08	***Over-torque Detection Time (Motor 1)***	♦R/W	0608	41545
P06.11	***Over-torque Detection Time (Motor 2)***	♦R/W	060B	41548

Range/Units (Format: 16-bit unsigned) — *Default*: 0.1

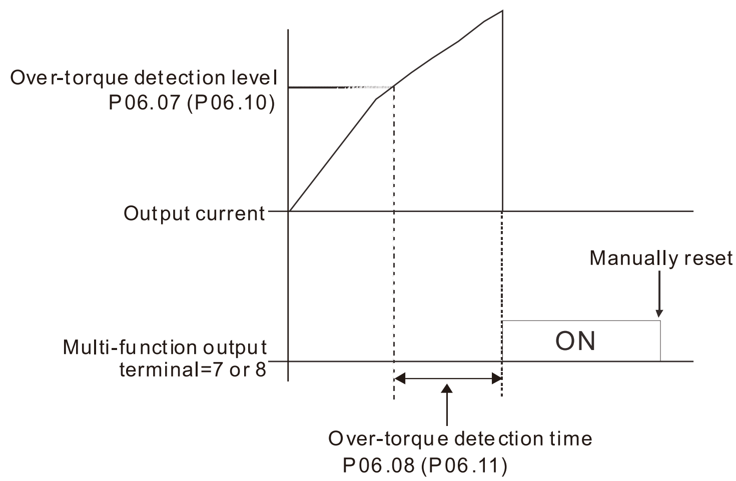
0.1–60.0 sec.

When the output current exceeds the over-torque detection level (P06.07 or P06.10) and also exceeds the over-torque detection time (P06.08 or P06.11), the over-torque detection follows the setting of P06.06 and P06.09.

- *When you set P06.06 or P06.09 to 1 or 3, an ot1 / ot2 warning displays while the drive keeps running after over-torque detection. The warning remains on until the output current is smaller than 5% of the over-torque detection level.*



- *When you set P06.06 or P06.09 to 2 or 4, an ot1 / ot2 warning displays and the drive stops running after over-torque detection. The drive does not run until you manually reset it.*



		Type	Hex Addr	Dec Addr
P06.13	***Electronic Thermal Relay Selection 1 (Motor 1)***	♦R/W	060D	41550
P06.27	***Electronic Thermal Relay Selection 2 (Motor 2)***	♦R/W	061B	41564

Range/Units (Format: 16-bit binary)	Default
0: Inverter motor (with external forced cooling) 1: Standard motor (motor with fan on the shaft) 2: Disable	2

These parameters prevent self-cooled motors from overheating under low speed. Use an electronic thermal relay to limit the drive's output power.

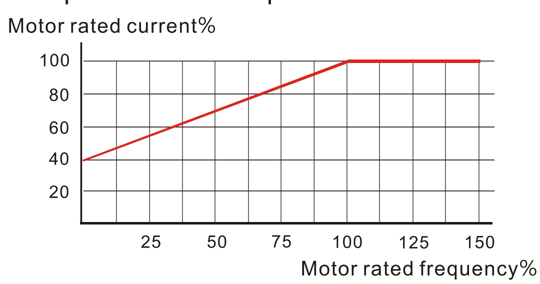
- *Setting the parameter to 0 is suitable for an inverter motor (motor fan using an independent power supply). For this kind of motor, there is no significant correlation between cooling capacity and motor speed. Therefore, the action of electronic thermal relays remains stable in low speed to ensure the load capability of the motor in low speed.*
- *Setting the parameter to 1 is suitable for standard motor (motor fan is fixed on the rotor shaft). For this kind of motor, the cooling capacity is lower in low speed; therefore, the action of an electronic thermal relay reduces the action time to ensure the life of motor.*
- *When the power is cycled frequently, the electronic thermal relay protection is reset when the power is switched OFF; therefore, even setting the parameter to 0 or 1 may not protect the motor well. If there are several motors connected to one drive, install an electronic thermal relay in each motor.*

		Type	Hex Addr	Dec Addr
P06.14	***Electronic Thermal Relay Action Time 1 (Motor 1)***	♦R/W	060E	41551
P06.28	***Electronic Thermal Relay Action Time 2 (Motor 2)***	♦R/W	061C	41565
	Range/Units (Format: 16-bit unsigned)	*Default*		
	30.0–600.0 sec.	60.0		

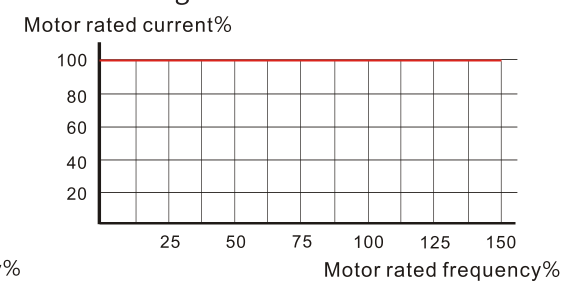
The electronic thermal relay amperage threshold is based on 150% of the parameter value in "Full Load Current for Induction Motor X" (P5.01 for motor 1, P5.13 for motor 2).

Set Parameter 06.14 or 06.28 for the amount of time the motor exceeds this threshold. Proper setup will prevent motor damage due to overheating. When it reaches the setting, the drive displays "EoL3 / EoL4", and the motor coasts to stop.

Use this parameter to set the action time of the electronic thermal relay. It works based on the I2t characteristic curve of electronic thermal relay, the output frequency and current of the drive, and the operation time to prevent the motor from overheating.



Motor cooling curve with shaft-fixed fan

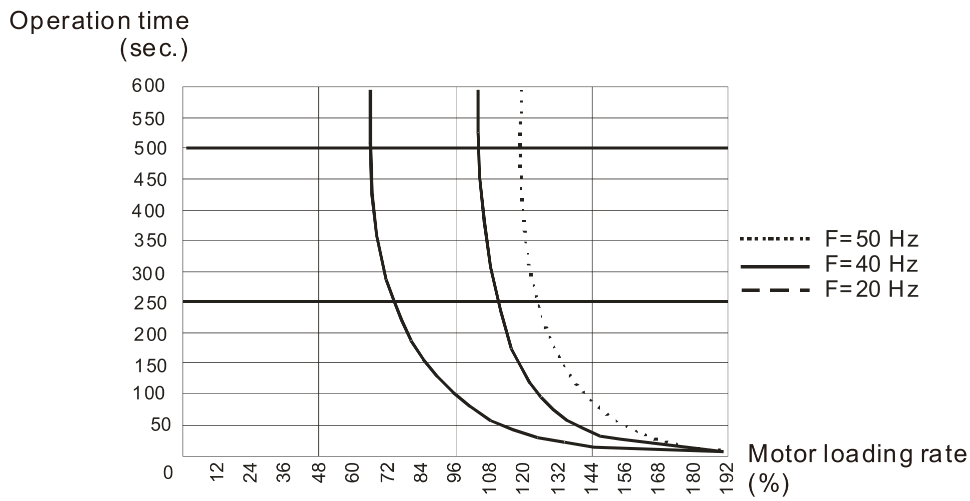


Motor cooling curve with independent fan

The action of the electronic thermal relay depends on the settings for P06.13 and P06.27.

1) P06.13 or P06.27 is set to 0 (using inverter motor):
   When the output current of the drive is higher than 150% of the motor rated current (refer to the motor rated current % corresponded to the motor rated frequency in the motor cooling curve with independent fan), the drive starts to count the time. The electronic thermal relay acts when the accumulated time exceeds P06.14 or P06.28.

2) P06.13 or P06.27 is set to 1 (using standard motor):
When the output current of the drive is higher than 150% of the motor rated current (refer to the motor rated current % corresponded to the motor rated frequency in the motor cooling curve with shaft-fixed fan), the drive starts to count the time. The electronic thermal relay acts when the accumulated time exceeds P06.14 or P06.28.
The actual electronic thermal relay action time adjusts according to the drive output current (shown as the motor loading rate %). The action time is short when the current is high, and the action time is long when the current is low. Refer to the following diagram.



		Type	Hex Addr	Dec Addr
P06.15	***Temperature Level Overheat (OH) Warning***	♦R/W	060F	41552
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–110.0°C	Model dependent		

P06.15 sets the drive's internal IGBT overheat warning level. When the temperature is higher than P06.15 setting, the oH1 fault displays and the warning remains but it does not affect the drive operation.

- *Use this parameter to check the IGBT temperature in order to take precautionary measures to decrease the temperature and maintain the IGBT's normal operation.*
- *When the IGBT temperature reaches 5°C higher than the maximum setting value for P06.15, IGBT overheating occurs and the drive stops. Refer to oH1 fault descriptions for details.*

		Type	Hex Addr	Dec Addr
P06.16	***Stall Prevention Limit Level (Weak Magnetic Field Current Stall Prevention Level)***	♦R/W	0610	41553
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–100% (Refer to P06.03–P06.04)	100		

P06.16 works in VF or SVC control mode.

Sets the over-current stall prevention level when the motor's operation frequency is larger than P01.01 (base frequency).

Example:

When P06.03 = 150%, P06.04 = 100% and P06.16 = 80%.

- *The over-current stall prevention level during acceleration:*
  *P06.03 * P06.16 = 150 x 80% = 120%.*
- *The over-current stall prevention level during operation:*
  *P06.04 * P06.16 = 100 x 80% = 80%.*

		Type	Hex Addr	Dec Addr
P06.17	***Fault Record 1***	Read	0611	41554
P06.18	***Fault Record 2***	Read	0612	41555
P06.19	***Fault Record 3***	Read	0613	41556
P06.20	***Fault Record 4***	Read	0614	41557
P06.21	***Fault Record 5***	Read	0615	41558
P06.22	***Fault Record 6***	Read	0616	41559

Range/Units (Format: 16-bit binary) — *Default*: 0

0: No fault record
1: Over-current during acceleration (ocA)
2: Over-current during deceleration (ocd)
3: Over-current during steady operation (ocn)
4: Ground fault (GFF)
6: Over-current at stop (ocS)
7: Over-voltage during acceleration (ovA)
8: Over-voltage during deceleration (ovd)
9: Over-voltage during constant speed (ovn)
10: Over-voltage at stop (ovS)
11: Low-voltage during acceleration (LvA)
12: Low-voltage during deceleration (Lvd)
13: Low-voltage during constant speed (Lvn)
14: Low-voltage at stop (LvS)
15: Phase loss protection (orP)
16: IGBT overheating (oH1)
18: IGBT temperature detection failure (tH1o)
21: Over load (oL)
22: Electronic thermal relay 1 protection (EoL1)
23: Electronic thermal relay 2 protection (EoL2)
24: Motor PTC overheating (oH3)
26: Over torque 1 (ot1)
27: Over torque 2 (ot2)
28: Under current (uC)
31: EEPROM read error (cF2)
33: U-phase error (cd1)
34: V-phase error (cd2)
35: W-phase error (cd3)
36: cc (current clamp) hardware error (Hd0)
37: oc (over-current) hardware error (Hd1)
40: Auto-tuning error (AUE)
41: PID loss AI-C (AFE)
48: AI-C loss (ACE)
49: External fault (EF)
50: Emergency stop (EF1)
51: External base block (bb)
52: Password is locked (Pcod)
54: Illegal command (CE1)
55: Illegal data address (CE2)
56: Illegal data value (CE3)
57: Data is written to read-only address (CE4)

58: Modbus transmission time-out (CE10)
63: Over slip error (oSL)
82: Output phase loss U phase (oPL1)
83: Output phase loss V phase (oPL2)
84: Output phase loss W phase (oPL3)
87: Low frequency overload protection (oL3)
142: Auto-tune error 1 (DC test stage) (AuE1)
143: Auto-tune error 2 (High frequency test stage) (AuE2)
149: Total resistance measurement fault (AUE5)
150: No-load current IO measurement fault (AUE6)
151: dq axis inductance measurement fault (AUE7)
152: High frequency injection measurement fault (AUE8)
157: Pump PID feedback error (dEv)

These parameters record when the fault occurs and forces a stop.

- *When low-voltage at stop fault (LvS) occurs, the fault is not recorded. When low-voltage during operation faults (LvA, Lvd, Lvn) occur, the faults are recorded.*
- *When dEb function is valid and enabled, the drive executes dEb and records fault code 62 to P06.17–P06.22 and P14.70–P14.73 simultaneously.*

		Type	Hex Addr	Dec Addr
P06.23	***Fault Output Option 1***	♦R/W	0617	41560
P06.24	***Fault Output Option 2***	♦R/W	0618	41561
P06.25	***Fault Output Option 3***	♦R/W	0619	41562
P06.26	***Fault Output Option 4***	♦R/W	061A	41563

Range/Units (Format: 16-bit unsigned) — *Default*

0–65535 (refer to bit table for fault code) — 0

Use these parameters with multi-function output terminal (set P06.23–P06.26 to 35–38) for the specific requirement. When a fault occurs, the corresponding terminals are activated. Convert the binary value to a decimal value before you enter the value for P06.23–P06.26.

Fault Code Table

Fault Code	bit 0	bit 1	bit 2	bit 3	bit 4	bit 5	bit 6
	current	Volt.	OL	SYS	FBK	EXI	CE
0: No fault record							
1: Over-current during acceleration (ocA)	●						
2: Over-current during deceleration (ocd)	●						
3: Over-current during steady operation (ocn)	●						
4: Ground fault (GFF)	●						
6: Over-current at stop (ocS)	●						
7: Over-voltage during acceleration (ovA)		●					
8: Over-voltage during deceleration (ovd)		●					
9: Over-voltage during constant speed (ovn)		●					
10: Over-voltage at stop (ovS)		●					
11: Low-voltage during acceleration (LvA)		●					
12: Low-voltage during deceleration (Lvd)		●					
13: Low-voltage during constant speed (Lvn)		●					
14: Low-voltage at stop (LvS)		●					
15: Phase loss protection (orP)		●					
16: IGBT over-heat (oH1)			●				
18: IGBT temperature detection failure (tH1o)			●				
21: Drive over-load (oL)			●				
22: Electronics thermal relay 1 protection (EoL1)			●				
23: Electronics thermal relay 2 protection (EoL2)			●				
24: Motor PTC overheating (oH3)			●				
26: Over torque 1 (ot1)			●				
27: Over torque 2 (ot2)			●				
28: Under current (uC)	●						
31: EEPROM read error (cF2)				●			
33: U-phase error (cd1)				●			
34: V-phase error (cd2)				●			
35: W-phase error (cd3)				●			
36: cc (current clamp) hardware error (Hd0)				●			
37: oc (over-current) hardware error (Hd1)				●			
40: Auto-tuning error (AUE)				●			
41: PID loss AI-C (AFE)					●		
48: AI-C loss (ACE)					●		
49: External fault (EF)						●	
50: Emergency stop (EF1)						●	

Fault Code	bit 0 current	bit 1 Volt.	bit 2 OL	bit 3 SYS	bit 4 FBK	bit 5 EXI	bit 6 CE
51: External base block (bb)						●	
52: Password is locked (Pcod)				●			
54: Illegal command (CE1)							●
55: Illegal data address (CE2)							●
56: Illegal data value (CE3)							●
57: Data is written to read-only address (CE4)							●
58: Modbus transmission time-out (CE10)							●
63: Over slip error (oSL)						●	
82: U-phase output phase loss (oPL1)	●						
83: V-phase output phase loss (oPL2)	●						
84: W-phase output phase loss (oPL3)	●						
87: Low frequency overload protection (oL3)			●				
142: Auto-tuning error 1 (no feedback current error) (AUE1)				●			
143: Auto-tuning error 2 (motor phase loss error) (AUE2)				●			
149: Total resistance measurement fault (AUE5)				●			
150: No-load current IO measurement fault (AUE6)				●			
151: dq axis inductance measurement fault (AUE7)				●			
152: High frequency injection measurement fault (AUE8)				●			
157: Pump PID feedback error (dEv)				●			

		Type	Hex Addr	Dec Addr
P06.29	***PTC Thermistor Detection Selection***	♦R/W	061D	41566

Range/Units (Format: 16-bit binary) — *Default*: 0

0: Warn and continue operation
1: Fault and ramp to stop
2: Fault and coast to stop
3: No warning

P06.29 sets the operation mode of a drive after detecting PTC.

Running a motor at low frequency for a long time reduces the cooling function of the motor fan. To prevent damage to the motor from overheating, use a Positive Temperature Coefficient (PTC) thermistor on the motor connected to the drive's analog input terminals.

		Type	Hex Addr	Dec Addr
P06.30	***PTC Thermistor Level***	♦R/W	061E	41567

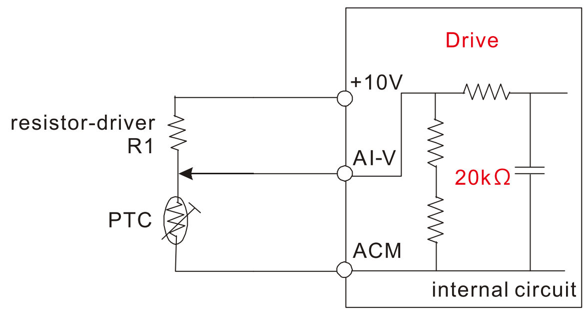
Range/Units (Format: 16-bit binary) — *Default*: 50.0

0.0–100.0%

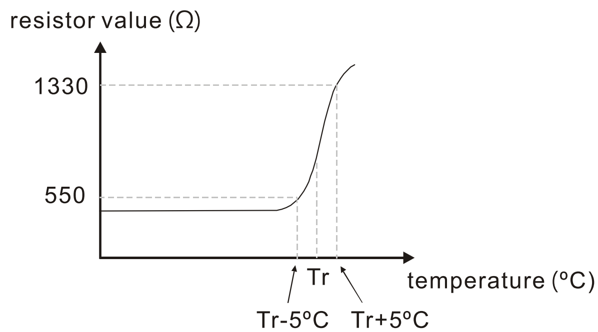
P06.30 sets AI-V / AI-C analog input function P03.00 to 6 [thermistor (PTC) input value)].

- *Use this parameter to set the PTC level; 100% PTC level corresponds to the maximum analog input value.*
- *When using the AI-V terminal, you must set P03.28 to 0 and switch AI dip switch to 0–10 V. The AI-V impedance is 20 KΩ in this configuration.*
- *When the temperature rises to the set protection level, the motor responds according to the settings for P06.29 and displays warning "oH3" (if P06.29 = 1–3). When the temperature is lower than the set protection level, you can press RESET key to clear the fault.*

- *The PTC uses the AI-V-input and is connected through divider resistance as shown below:*
    a) The voltage between +10V to ACM: lies within 10–11V.
    b) The impedance for AI-V is around 20K Ω. Recommended value for divider resistance is 1K–10K Ω.
    c) Please contact your motor dealer for the curve of temperature and resistance value for PTC. Protection level (P06.30) = V+10 * (RPTC//20K) / [R1+(RPTC//20K)]
        i) V+10: voltage between +10V-ACM actual value
        ii) RPTC: motor PTC overheat protection level;
        iii) 20K Ω: the AI-V input impedance;
        iv) R1: divider resistance (recommended value: 1–10k Ω)



Take the standard PTC thermistor as an example: if the protection level is 1330 Ω, the actual voltage between +10V-ACM is 10.5 V and divider resistance R1 is 4.4k Ω.



Refer to the following calculation when P06.30 is set to 23% and motor temperature overheating protection level is 1330Ω:

1330//20000 = (1330*20000) / (1330+20000) = 1247.07
10.5 * 1247.07 / (4400+1247.07) = 2.32 (V) = 2.3 (V)
P06.30 = 2.3 / 10 V * % = 23%

		Type	*Hex Addr*	*Dec Addr*
P06.31	***Frequency Command at Malfunction***	Read	061F	41568
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.0 Hz	0		

When a malfunction occurs, check the current Frequency command. If it happens again, it overwrites the previous record

		Type	*Hex Addr*	*Dec Addr*
P06.32	***Output Frequency at Malfunction***	Read	0620	41569
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.0 Hz	0		

When a malfunction occurs, check the current output frequency. If it happens again, it overwrites the previous record.

		Type	*Hex Addr*	*Dec Addr*
P06.33	***Output Voltage at Malfunction***	Read	0621	41570
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–6553.5 V	0		

When a malfunction occurs, check the current output voltage. If it happens again, it overwrites the previous record.

		Type	*Hex Addr*	*Dec Addr*
P06.34	***DC bus Voltage at Malfunction***	Read	0622	41571
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–6553.5 V	0		

When a malfunction occurs, check the current DC bus voltage. If it happens again, it overwrites the previous record.

		Type	*Hex Addr*	*Dec Addr*
P06.35	***Output Current at Malfunction***	Read	0623	41572
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–655.35 Amp	0		

When a malfunction occurs, check the current output current. If it happens again, it overwrites the previous record.

		Type	*Hex Addr*	*Dec Addr*
P06.36	***IGBT Temperature at Malfunction***	Read	0624	41573
	Range/Units (Format: 16-bit signed)	*Default*		
	-3276.7–3276.7 °C	0		

When a malfunction occurs, check the current IGBT temperature. If it happens again, it overwrites the previous record.

		Type	*Hex Addr*	*Dec Addr*
P06.38	***Motor Speed at Malfunction***	Read	0626	41575
	Range/Units (Format: 16-bit signed)	*Default*		
	-32767–32767 rpm	0		

When a malfunction occurs, check the current motor speed in rpm. If it happens again, it overwrites the previous record.

		Type	Hex Addr	Dec Addr
P06.39	***Torque Command at Malfunction***	Read	0627	41576
	Range/Units (Format: 16-bit signed)	*Default*		
	-32767–32767%	0		

When a malfunction occurs, check the current torque command. If it happens again, it overwrites the previous record.

		Type	Hex Addr	Dec Addr
P06.40	***Status of the Multi-function Input Terminal at Malfunction***	Read	0628	41577
P06.41	***Status of the Multi-function Output Terminal at Malfunction***	Read	0629	41578
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0000h–FFFFh	0		

When a malfunction occurs, check the current status of the multi-function input/output terminals. If it happens again, it overwrites the previous record.

		Type	Hex Addr	Dec Addr
P06.42	***Drive Status at Malfunction***	Read	062A	41579
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0000h–FFFFh	0		

When a malfunction occurs, check the current drive status (communication address 2101H). If it happens again, it overwrites the previous record.

		Type	Hex Addr	Dec Addr
P06.45	***Output Phase Loss Detection Action (OPHL)***	♦R/W	062D	41582
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning	3		

The OPHL protection is enabled when P06.45 is not set to 3.

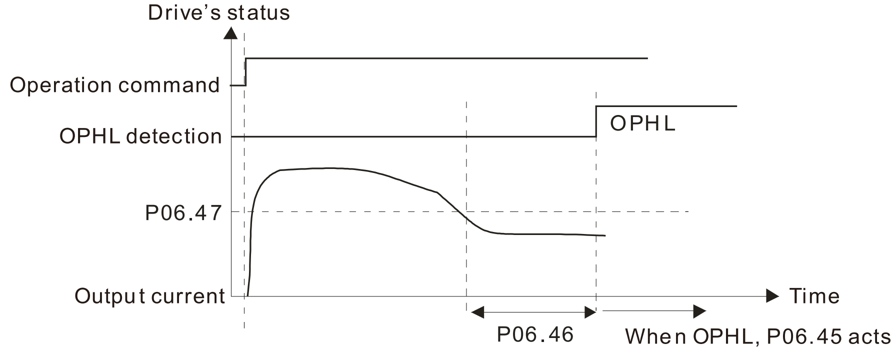
		Type	Hex Addr	Dec Addr
P06.46	***Detection Time for Output Phase Loss***	♦R/W	062E	41583
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.000–65.535 sec.	0.500		

		Type	Hex Addr	Dec Addr
P06.47	***Current Detection Level for Output Phase Loss***	♦R/W	062F	41584
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–100.00%	1.00		

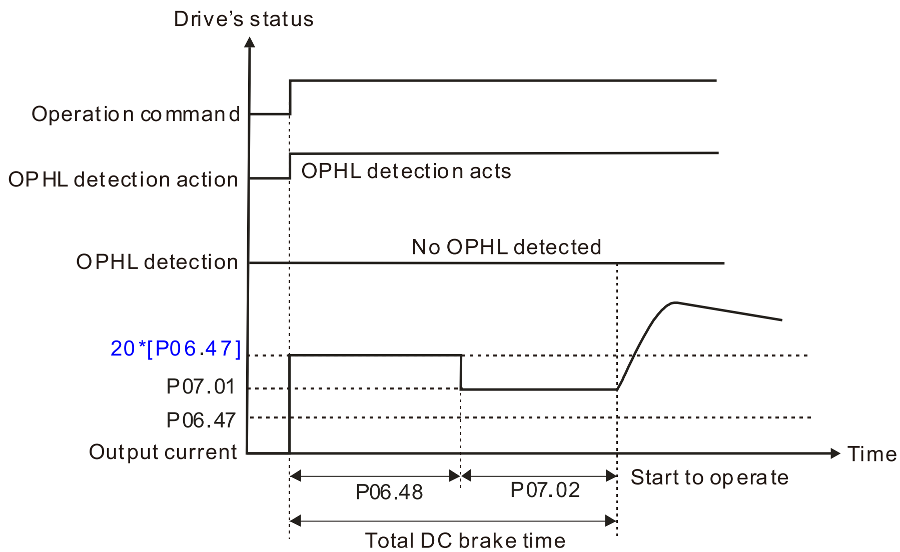
		Type	Hex Addr	Dec Addr
P06.48	**DC Brake Time for Output Phase Loss**	♦R/W	0630	41585
	Range/Units (Format: 16-bit unsigned)	Default		
	0.000–65.535 sec.	0.000		

Setting P06.48 to 0 disables the OPHL detection function before operation.

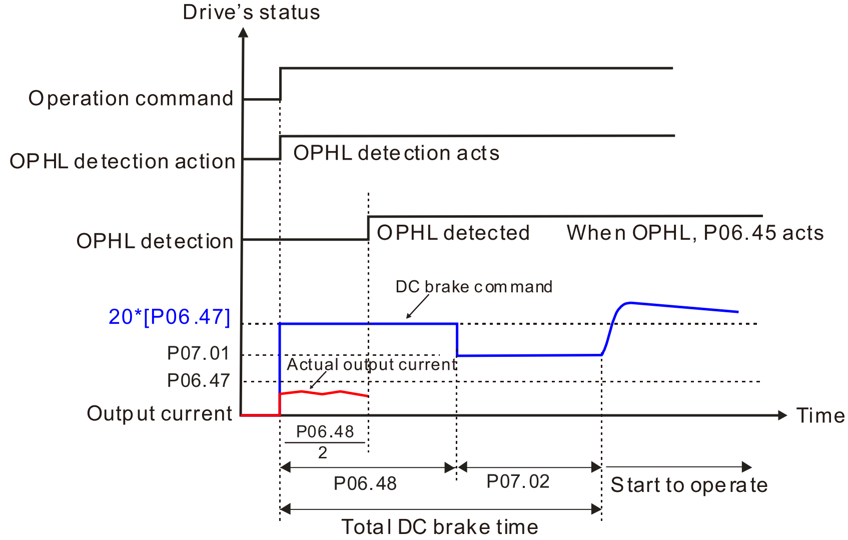
- *Status 1:*
  The drive is in operation
  When any phase is less than the P06.47 setting, and exceeds the P06.46 setting time, the drive executes according to the P06.45 setting.



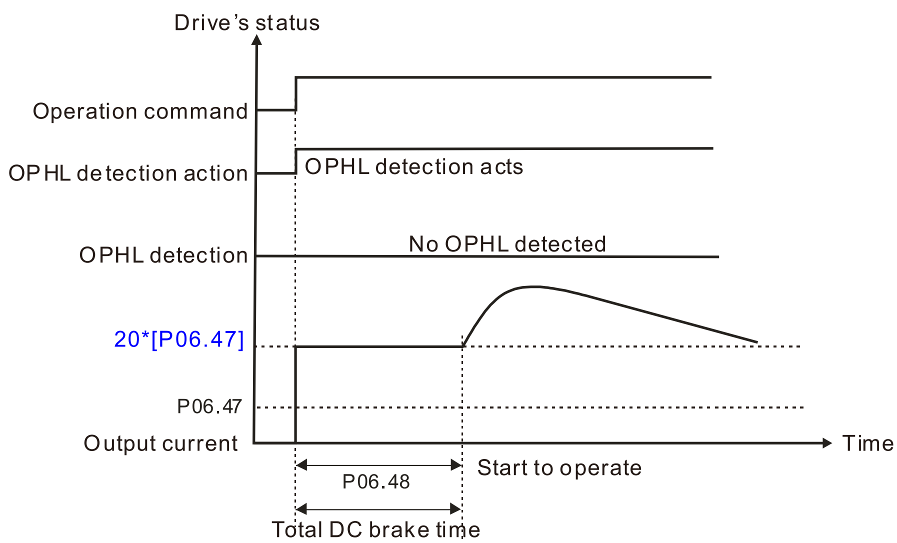
- *Status 2:*
  The drive is in STOP; P06.48 ≠ 0; P07.02 ≠ 0
  When the drive starts, it executes P06.48 first, and then executes P07.02 (DC brake). The DC brake current level in this state includes two parts: one is 20 times the P06.47 setting value in P06.48 setting time; the other is the P07.01 setting value in P07.02 setting time. The total DC brake time T = P06.48 + P07.02. In this period, if an OPHL occurs within the time for P06.48, the drive executes the P06.45 setting after the drive starts counting for half the time of P06.48.



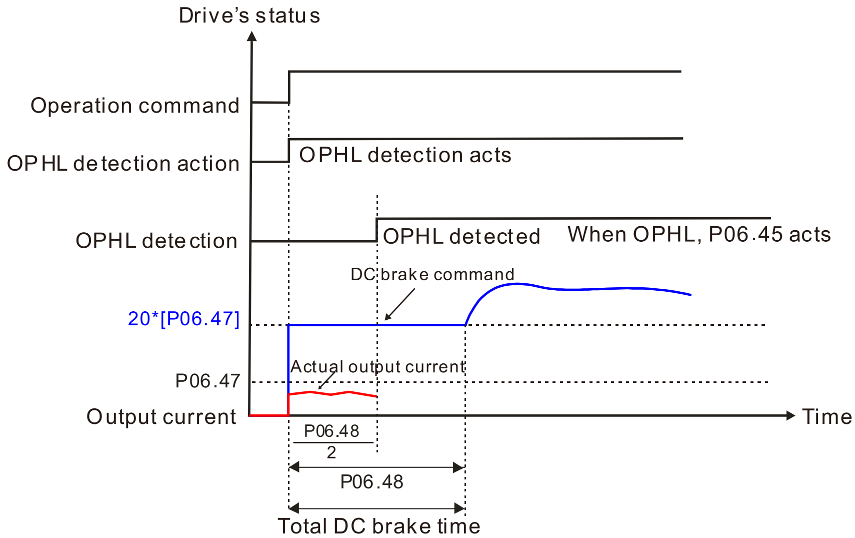
- *Status 2-2:*
  P06.48 ≠ 0; P07.02 ≠ 0 (OPHL detected before operation)
  In this period, if an OPHL occurs within the time for P06.48, the drive executes the P06.45 setting after the drive starts counting for half the time of P06.48.



- *Status 3:*
  The drive is in STOP; P06.48 ≠ 0; P07.02=0
  When the drive starts, it executes P06.48 as the DC brake. The DC brake current level is 20 times the P06.47 setting value. In this period, if an OPHL occurs within the time for P06.48, the drive executes the P06.45 setting after the drive starts counting for half the time of P06.48.



- *Status 3-2:*
  P06.48 ≠ 0; P07.02 = 0 (OPHL detected before operation)
  In this period, if an OPHL occurs within the time for P06.48, the drive executes the P06.45 setting after the drive starts counting for half the time of P06.48.



P06.49	***LvX Auto-reset***	Type	Hex Addr	Dec Addr
		♦R/W	0631	41586
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable	0		
	1: Enable			

In the event of any low voltage fault on the DC bus (LvS, LvN, LvA, LvD faults), this parameter will automatically reset the drive if enabled.

P06.53	***Input Phase Loss Detection Action (OrP)***	Type	Hex Addr	Dec Addr
		♦R/W	0635	41590
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Fault and ramp to stop	0		
	1: Fault and coast to stop			

The drive executes the input phase loss protection according to P06.53.

		Type	Hex Addr	Dec Addr
P06.55	***Derating Protection***	♦R/W	0637	41592
	Range/Units (Format: 16-bit binary)	Default		
	0: Constant rated current and limit carrier frequency by load current and temperature 1: Constant carrier frequency and limit load current by setting carrier frequency 2: Constant rated current (same as setting 0), but close current limit	0		

Allowable maximum output frequency and the minimum carrier frequency limit in control mode:

For VF and SVC modes:

When the maximum output frequency is 599 Hz, the minimum carrier frequency is 6k.

Setting 0:

- *When the operating point is greater than the derating curve (when the operating carrier frequency is greater than the rated carrier frequency), the rated current is constant, and carrier frequency (Fc) output by the drive decreases automatically according to the ambient temperature, overload output current and overload time. If overloads are not frequent, and the concern is only about the carrier frequency operating with the rated current for a long time, and changes to the carrier frequency due to short overload are acceptable, set to 0.*
- *Refer to Derating for Ambient Temperature, Altitude and Carrier Frequency for the carrier frequency derating level.*
- *Take GS13N-45P0 in normal load as an example: ambient temperature 50°C, UL open-type, and independent installation. When the carrier frequency is set to 10kHz, it corresponds to 55% of the rated output current. In the same condition for ambient temperature 40°C, it corresponds to 75% of rated output current. When the output current is higher than this value, it automatically decreases the carrier frequency according to the ambient temperature, output current and overload time. At this time, the overload capacity of the drive is 150% of the rated current.*

Setting 1:

- *When the operating point exceeds the derating curve 1, the carrier frequency is the setting value. Select this mode if the change of carrier frequency and motor noise caused by ambient temperature and frequent overload are not allowed. (Refer to P00.17.)*
- *Refer to Derating for Ambient Temperature, Altitude and Carrier Frequency for the rated current derating level. Take GS13N-45P0 in variable torque as an example. If you need to maintain the carrier frequency at 10kHz, decrease the rated current to 55%. The OL protection executes when the current is 120% * 55% = 66% for one minute; therefore, you must operate using the values within the derating curve to keep the carrier frequency constant.*

Setting 2:

- *The protection method and action are the same as setting value 0, but it disables the current limit when output current is the derating ratio ×120% (default value) in variable torque and when the output current is the derating ratio ×180% (default value) in constant torque. The advantage is that it provides a higher starting output current when the carrier frequency setting is higher than the default. However, the carrier frequency derates easily when it overloads.*
  *Example: when P06.55 = 0 or 1, over-current stall prevention level = Ratio * P06.03. When P06.55 = 2, the over-current stall prevention level = P06.03.*

Use this parameter with P00.16 and P00.17.

The ambient temperature also affects the derating. Refer to Derating Curve for Ambient Temperature and Altitude.

Example:

Take *GS13N-45P0* in variable torque with ambient temperature 50°C, UL open-type, and independent installation. When the carrier frequency is set to 10kHz, it corresponds to 55% of the rated output current. If used for ambient temperature 60°C, it corresponds to 55% * 75% of the rated output current.

		Type	Hex Addr	Dec Addr
P06.56	***PT100 RTD Voltage Level 1***	♦R/W	0638	41593
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.000–10.000 V	5.000		

		Type	Hex Addr	Dec Addr
P06.57	***PT100 RTD Voltage Level 2***	♦R/W	0639	41594
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.000–10.000 V	7.000		

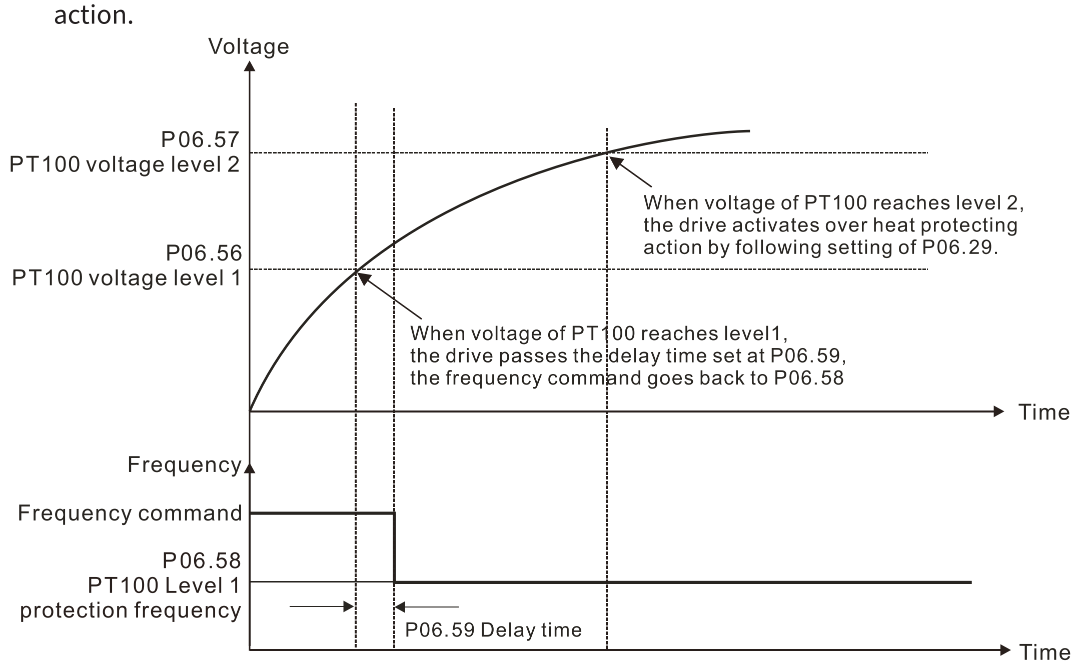
Condition settings: PT100 voltage level P06.57 > P06.56.

		Type	Hex Addr	Dec Addr
P06.58	***PT100 RTD Level 1 Frequency Protection***	♦R/W	063A	41595
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.0 Hz	0.00		

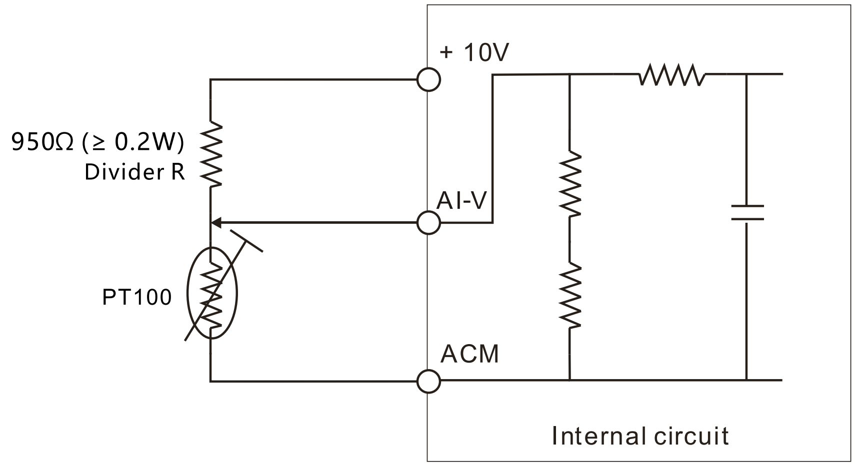
		Type	Hex Addr	Dec Addr
P06.59	***PT100 RTD Activation Level 1 Protection Frequency Delay Time***	♦R/W	063B	41596
	Range/Units (Format: 16-bit binary)	*Default*		
	0–6000 sec.	60		

PT100 operation instructions:

1) Use voltage type analog input (AI-V voltage 0–10 V) and select PT100 RTD mode.
2) Set P03.00 =11 and P03.28 = 0.
3) Need to connect divider resistance and recommended voltage is 950Ω (≥0.2W).
4) There are two types of action levels for PT100 RTD. The diagram below shows the protection action.



PT100 RTD wiring diagram:



Example:

When using PT100 RTD, if the motor temperature is higher than 135°C (275°F), the drive starts to count the delay time for auto-deceleration (P06.59). The drive decreases the motor frequency to the setting for P06.58 when it reaches the delay time count value. The drive operates at the frequency set for P.06.58 until the motor temperature is lower than 135°C (275°F). If the motor temperature is higher than 150°C (302°F), the drive automatically decelerates to STOP and displays the warning “oH3”.

Set up process:

1) Refer to the PT100 RTD wiring diagram on the previous page for wiring.
2) Refer to the RTD temperature and resistance comparison table
   Temperature = 135°C, resistance = 151.71 Ω, input current: 9 mA, voltage: about 1.37 VDC
   Temperature = 150°C, resistance = 157.33 Ω, input current: 9 mA, voltage: about 1.42 VDC
3) When the RTD temperature > 135°C, the drive decelerates to the specified operation frequency automatically. Then, P06.56 = 1.37 V and P06.58 = 10Hz. (When P06.58 = 0, it disables the specified operation frequency.)
4) When RTD temperature > 150°C, the drive outputs a fault, decelerates to STOP, and displays the warning “oH3”. Then, P06.57 = 1.42 V and P06.29 = 1 (fault and ramp to stop).

		Type	Hex Addr	Dec Addr
P06.60	***Software Detection GFF Current Level***	♦R/W	063C	41597
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–6553.5%	60.0		

		Type	Hex Addr	Dec Addr
P06.61	***Software Detection GFF Filter Time***	♦R/W	063D	41598
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–655.35 sec.	0.10		

When the drive detects that the unbalanced three-phase output current is higher than the setting for P06.60, GFF protection activates. The drive then stops output.

		Type	Hex Addr	Dec Addr
P06.63	**Operation Time of Fault Record 1 (Day)**	Read	063F	41600
P06.65	**Operation Time of Fault Record 2 (Day)**	Read	0641	41602
P06.67	**Operation Time of Fault Record 3 (Day)**	Read	0643	41604
P06.69	**Operation Time of Fault Record 4 (Day)**	Read	0645	41606
P06.90	**Operation Time of Fault Record 5 (Day)**	Read	065A	41627
P06.92	**Operation Time of Fault Record 6 (Day)**	Read	065C	41629

Range/Units (Format: 16-bit unsigned) — *Default*

0–65535 days — 0

		Type	Hex Addr	Dec Addr
P06.64	**Operation Time of Fault Record 1 (Min.)**	Read	0640	41601
P06.66	**Operation Time of Fault Record 2 (Min.)**	Read	0642	41603
P06.68	**Operation Time of Fault Record 3 (Min.)**	Read	0644	41605
P06.70	**Operation Time of Fault Record 4 (Min.)**	Read	0646	41607
P06.91	**Operation Time of Fault Record 5 (Min.)**	Read	065B	41628
P06.93	**Operation Time of Fault Record 6 (Min.)**	Read	065D	41630

Range/Units (Format: 16-bit unsigned) — *Default*

0–1439 min.

If there is any malfunction when the drive operates, P06.17–P06.22 records the malfunctions, and P06.63–P06.70 records the operation time for four sequential malfunctions. Check if there is any problem with the drive according to the interval of the recorded fault.

Example:

The first error: ocA occurs after motor drive operates for 1000 minutes.

The second error: ocd occurs after another 1000 minutes.

The third error: ocn occurs after another 1000 minutes.

The fourth error: ocA occurs after another 1000 minutes.

The fifth error: ocd occurs after another 1000 minutes.

The sixth error: ocn occurs after another 1000 minutes.

Then, P06.17–P06.22 and P06.63–P06.70 are recorded as follows:

Parameter	1st fault	2nd fault	3rd fault	4th fault	5th fault	6th fault
P06.17	ocA	ocd	ocn	ocA	ocd	ocn
P06.18	0	ocA	ocd	ocn	ocA	ocd
P06.19	0	0	ocA	ocd	ocn	ocA
P06.20	0	0	0	ocA	ocd	ocn
P06.21	0	0	0	0	ocA	ocd
P06.22	0	0	0	0	0	ocA
P06.63	1000	560	120	1120	680	240
P06.64	0	1	2	2	3	4
P06.65	0	1000	560	120	1120	680
P06.66	0	0	1	2	2	3
P06.67	0	0	1000	560	120	1120
P06.68	0	0	0	1	2	2
P06.69	0	0	0	1000	560	120
P06.70	0	0	0	0	1	2

By examining the time record, you can see that the last fault (P06.17) happened after the drive ran for four days and 240 minutes.

		Type	Hex Addr	Dec Addr
P06.71	***Low Current Setting Level***	♦R/W	0647	41608
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–100.0%	0.0		

		Type	Hex Addr	Dec Addr
P06.72	***Low Current Detection Time***	♦R/W	0648	41609
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–360.00 sec.	0.00		

		Type	Hex Addr	Dec Addr
P06.73	***Low Current Action***	♦R/W	0649	41610
	Range/Units (Format: 16-bit binary)	*Default*		
	0 : No function 1 : Fault and coast to stop 2 : Fault and ramp to stop by the second deceleration time 3 : Warn and continue operation	0		

The drive operates according to the setting for P06.73 when the output current is lower than the setting for P06.71 and when the time of the low current exceeds the detection time for P06.72. Use this parameter with the external multi-function output terminal setting 44 (low current output).

The low current detection function does not execute when drive is in sleep or standby status.

		Type	Hex Addr	Dec Addr
P06.80	***Fire Mode***	R/W	0650	41617
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable 1: Operates in a counterclockwise direction 2: Operates in a clockwise direction	0		

Use this parameter with multi-function input terminal setting 58 or 59, and multi-function output terminal setting 53.

0: Fire detection is invalid.

1: The motor operates in a counterclockwise direction (U, V, W).

2: The motor operates in a clockwise direction (U, W, V).

		Type	Hex Addr	Dec Addr
P06.81	***Operating Frequency in Fire Mode***	♦R/W	0651	41618
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.0 Hz	60.00		

		Type	Hex Addr	Dec Addr
P06.88	***Operation Times in Fire Mode***	Read	0658	41625
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–65535 times	0		

Group P07.xx Details – Special Parameters

		Type	Hex Addr	Dec Addr
P07.00	**Software Brake Chopper Action Level**	♦R/W	0000	41793
	Range/Units (Format: 16-bit unsigned)	Default		
	120V / 230V models: 350.0–450.0 VDC	370.0		
	460V models: 700.0–900.0 VDC	740.0		

P07.00 sets the DC bus voltage at which the brake chopper is activated. Choose a suitable braking resistor to achieve the optimal deceleration performance. Refer to the Accessories chapter for information about braking resistors.

		Type	Hex Addr	Dec Addr
P07.01	**DC Brake Current Level**	♦R/W	0701	41794
	Range/Units (Format: 16-bit unsigned)	Default		
	0–100%	0		

P07.01 sets the level of the DC brake current output to the motor at start-up and stop. When setting the DC brake current, the rated current (P00.01) is 100%. It is recommended that you start with a low DC brake current level and then increase until you reach the proper holding torque. However, the DC brake current cannot exceed the motor's rated current to prevent the motor from burnout. Therefore, DO NOT use the DC brake for mechanical retention, otherwise injury or accident may occur.

		Type	Hex Addr	Dec Addr
P07.02	**DC Brake Time at Start-up**	♦R/W	0702	41795
	Range/Units (Format: 16-bit unsigned)	Default		
	0.0–60.0 sec	0.0		

The motor may continue rotating due to external forces or the inertia of the motor itself. If you use the drive with the motor rotating, it may cause motor damage or trigger drive protection due to over-current. This parameter outputs DC current, generating torque to force the motor stop to get a stable start before motor operation. This parameter determines the duration of the DC brake current output to the motor when the drive starts up. Set this parameter to 0.0 to disable the DC brake at start-up.

		Type	Hex Addr	Dec Addr
P07.03	**DC Brake Time at STOP**	♦R/W	0703	41796
	Range/Units (Format: 16-bit unsigned)	Default		
	0.0–60.0 sec	0.0		

The motor may continue rotating after the drive stops output due to external forces or the inertia of the motor itself. This parameter outputs DC current, generating torque to force the motor stop after the drive stops output to make sure that the motor stops.

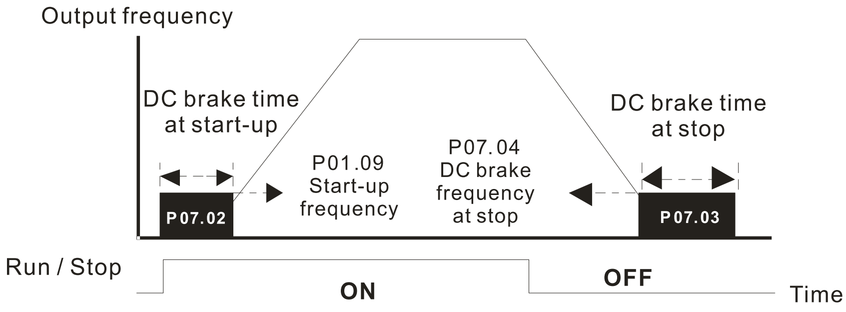
This parameter determines the duration of the DC Brake current output to the motor when braking. To enable the DC brake at STOP, you must set P00.22 (Stop Method) to 0 (ramp to stop). Set this parameter to 0.0 to disable the DC brake at stop.

Related parameters:

P00.22 Stop Method, P07.04 DC Brake Frequency at Start-up

		Type	Hex Addr	Dec Addr
P07.04	***DC Brake Frequency at STOP***	♦R/W	0704	41797
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.0 0 Hz	0.00		

Determines the start frequency of the DC brake before the drive ramps to stop. When this setting is less than P01.09 (Start-up Frequency), the start frequency for the DC brake begins at the minimum frequency.



DC Brake Output Timing Diagram

- *Use the DC brake before running the motor when the load is movable at stop, such as with fans and pumps. The motor is in free running status and in unknown rotation direction before the drive starts up. Execute the DC brake before you start the motor.*
- *Use the DC Brake at STOP when you need to brake the motor quickly or to control the positioning, such as with cranes or cutting machines.*

		Type	Hex Addr	Dec Addr
P07.05	***Voltage Increasing Gain***	♦R/W	0705	41798
	Range/Units (Format: 16-bit unsigned)	*Default*		
	1–200%	100		

When using speed tracking, adjust P07.05 to slow down the increasing voltage gain if there are errors such as oL or oc; however, the speed tracking time will be longer.

		Type	Hex Addr	Dec Addr
P07.06	***Restart after Momentary Power Loss***	♦R/W	0706	41799
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Stop operation 1: Speed tracking by the speed before the power loss 2: Speed tracking by the minimum output frequency	0		

P07.06 determines the operation mode when the drive restarts from a momentary power loss.

The power system connected to the drive may power off momentarily for many reasons. This function allows the drive to keep outputting voltages after the drive is repowered and does not cause the drive to stop.

1) Frequency tracking begins before momentary power loss and accelerates to the master Frequency command after the drive output frequency and motor rotator speed are synchronous. Use this setting when there is a lot of inertia with little resistance on the motor load. For example, in equipment with a large inertia flywheel, there is NO need to wait until the flywheel stops completely after a restart to execute the operation command; therefore, it saves time.
2) Frequency tracking starts from the minimum output frequency and accelerates to the master Frequency command after the drive output frequency and motor rotator speed are synchronous. Use this setting when there is little inertia and large resistance.

In PG control mode, the AC motor drive executes the speed tracking function automatically according to the PG speed when this setting is NOT set to 0.

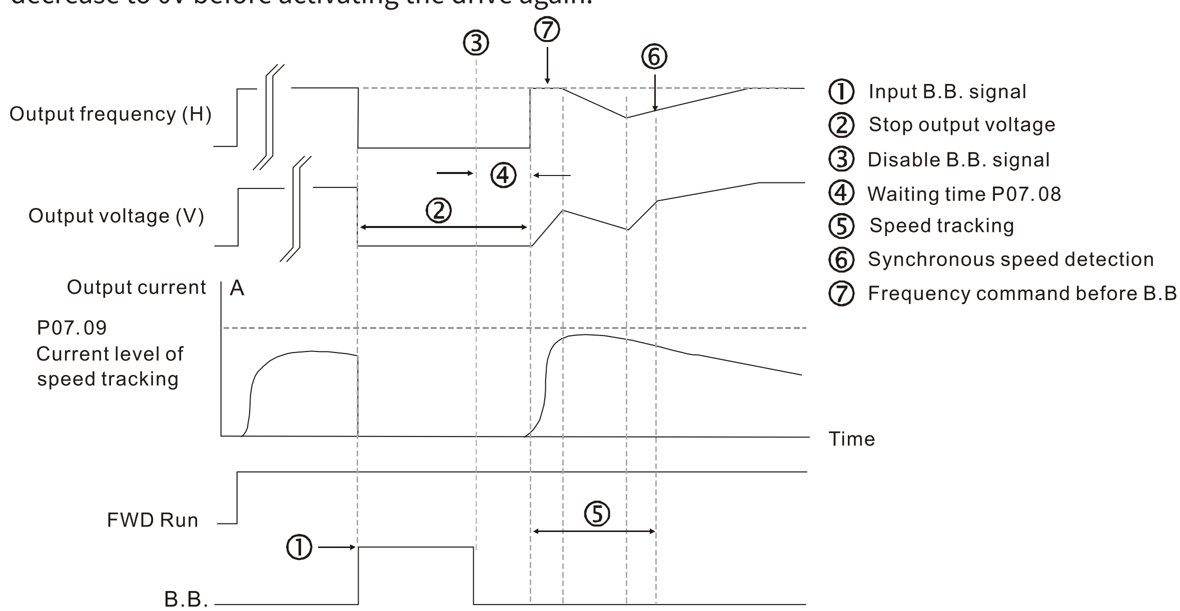
		Type	Hex Addr	Dec Addr
P07.07	***Allowed Power Loss Duration***	♦R/W	0707	41800
	Range/Units (Format: 16-bit binary)	*Default*		
	0.0–20.0 sec.	2.0		

Determines the maximum time of allowable power loss. If the duration of a power loss exceeds this parameter setting, the AC motor drive stops output after the power recovers.

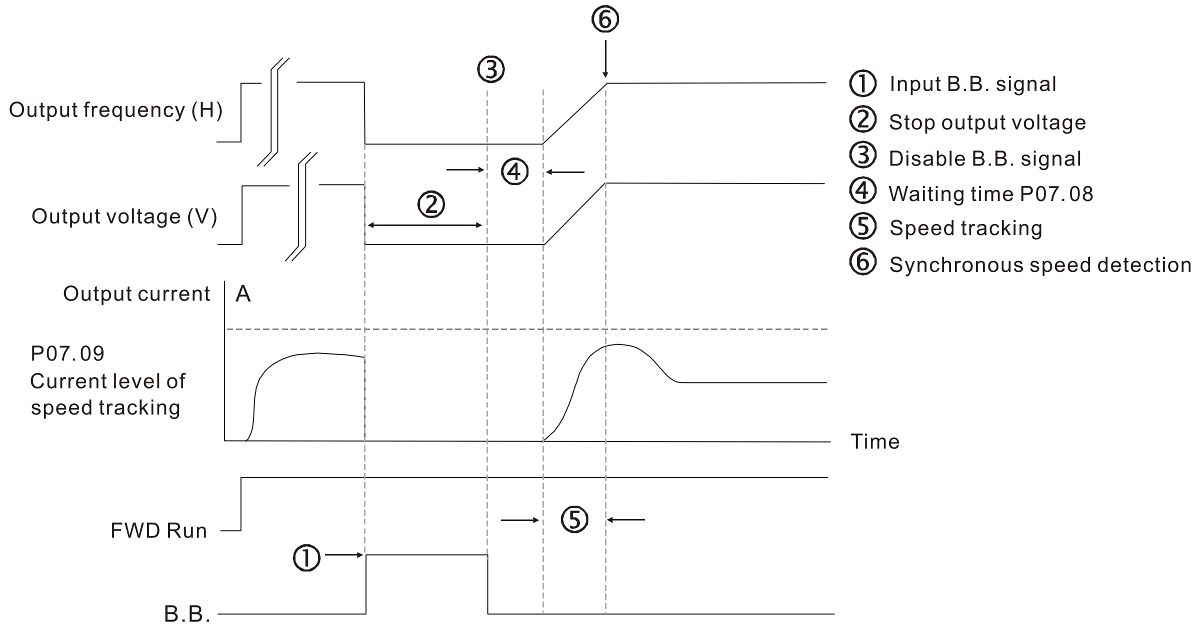
P07.06 is valid when the maximum allowable power loss time is ≤ 20 seconds and the AC motor drive displays “LU”. If the AC motor drive is powered off due to overload, even if the maximum allowable power loss time is ≤ 20 seconds, P07.06 is invalid after the power recovers.

		Type	Hex Addr	Dec Addr
P07.08	***Base Block Time***	♦R/W	0708	41801
	Range/Units (Format: 16-bit binary)	*Default*		
	0.0–60.0 sec.	0.5		

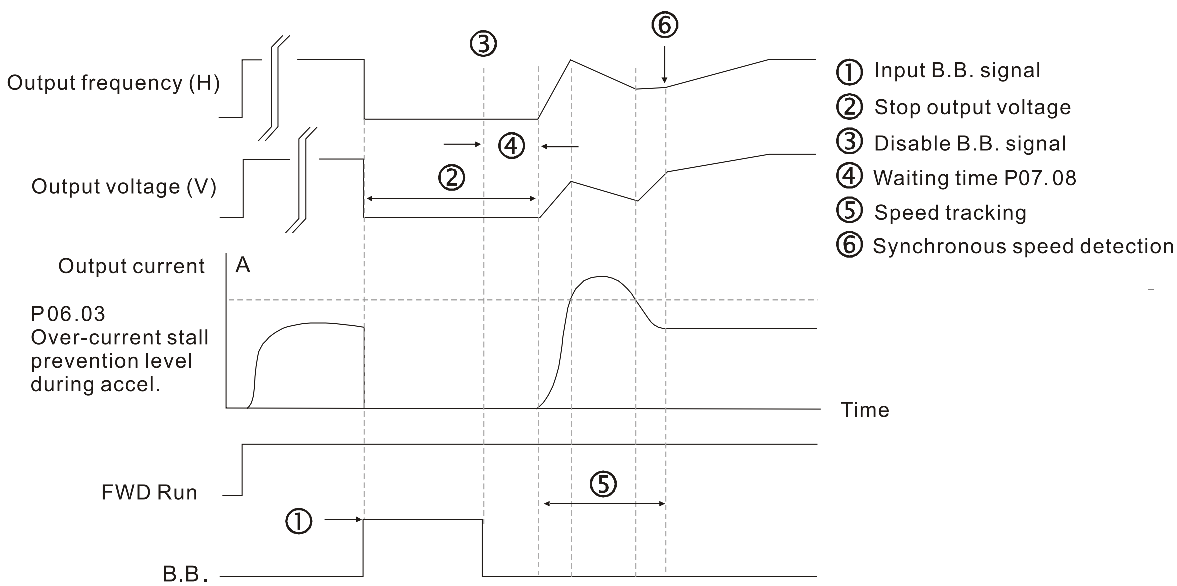
When momentary power loss is detected, the AC motor drive blocks its output and then waits for a specified period of time (determined by P07.08, called Base Block Time) before resuming operation. Set this parameter to the time that allows the residual voltage at the output side to decrease to 0V before activating the drive again.



B.B. Speed tracking: from last output frequency



B.B. Speed tracking: from minimum output frequency



Over-current stall prevention

		Type	*Hex Addr*	*Dec Addr*
P07.09	***Current Limit of Speed Tracking***	♦R/W	0709	41802
	Range/Units (Format: 16-bit unsigned)	*Default*		
	20–200%	100		

The AC motor drive executes speed tracking only when the output current is greater than the value set in P07.09.

The maximum current for speed tracking affects the synchronous time. The larger the parameter setting, the faster the synchronization occurs. However, if the parameter setting is too large, the overload protection function may be activated.

		Type	Hex Addr	Dec Addr
P07.10	***Restart after Fault Action***	♦R/W	070A	41803
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Stop operation 1: Speed tracking by current speed 2: Speed tracking by minimum output frequency	0		

Faults include: bb, oc, ov, occ. To restart after oc, ov, occ, you can NOT set P07.11 to 0.

		Type	Hex Addr	Dec Addr
P07.11	***Number of Times of Restart after Fault***	♦R/W	070B	41804
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–10	0		

After fault (allowed fault: oc, ov, occ) occurs, the AC motor drive can reset and restart automatically up to 10 times. If P07.11 is set to 0, the drive resets or restarts automatically after faults occur. The drive starts according to the P07.10 setting after restarting after fault.

If the number of faults exceeds the P07.11 setting, the drive does not reset and restart until you press "RESET" manually and execute the operation command again.

		Type	Hex Addr	Dec Addr
P07.12	***Speed Tracking during Start-up (Flying Restart)***	♦R/W	070C	41805
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable 1: Speed tracking by the maximum output frequency 2: Speed tracking by the motor frequency at start-up 3: Speed tracking by the minimum output frequency	0		

Speed tracking is suitable for punch presses, fans, and other large inertia loads. For example, a punch press usually has a large inertia flywheel, and the general stop method is coast to stop. If it needs to be restarted again, the flywheel may take 2–5 minutes or longer to stop. This parameter setting allows you to start the flywheel operating again without waiting until the flywheel stops completely.

		Type	Hex Addr	Dec Addr
P07.13	***dEb Function Selection***	♦R/W	070D	41806
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable 1: dEb with auto-acceleration / auto-deceleration, the drive does not output the frequency after the power is restored. 2: dEb with auto-acceleration / auto-deceleration, the drive outputs the frequency after the power is restored.	0		

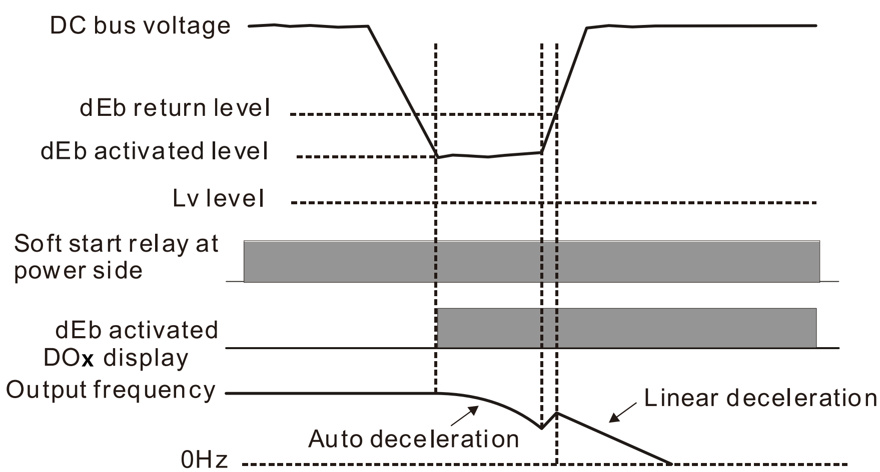
- *dEb (Deceleration Energy Backup) lets the motor decelerate to stop when momentary power loss occurs. When the power loss is instantaneous, use this function to let the motor decelerate to zero speed. If the power recovers at this time, the drive restarts the motor after the dEb return time.*
- *Lv return level: Default value depends on the drive power model.*
    a) Models for frame A, B, C, D = P06.00 / 60V (460V series) / 30V (120V/230V series)
- *Lv level: Default is P06.00.*
- *During dEb operation, other protection, such as ryF, ov, oc, occ, and EF may interrupt it, and these error codes are recorded.*

- *The STOP (RESET) command does not work during the dEb auto-deceleration, and the drive continues decelerating to stop. To make the drive coast to stop immediately, use another function (EF) instead.*
- *The B.B. function does not work when executing dEb. The B.B. function is enabled after the dEb function finishes.*
- *Even though the Lv warning does not display during dEb operation, if the DC bus voltage is lower than the Lv level, DOx = 10 (Low voltage warning) still operates.*
- *The following explains the dEb action:*
  When the DC bus voltage drops below the dEb setting level, the dEb function starts to work (soft start relay remains closed), and the drive executes auto-deceleration.

Situation 1:

Momentary power loss, or too low and unstable power voltage, or power supply sliding down because of sudden heavy load. P07.13 = 1 and power recovers.

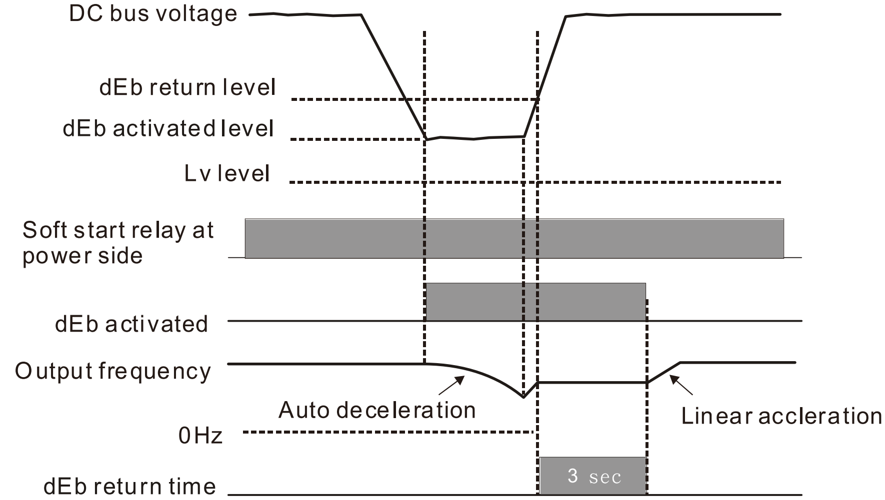
When the power recovers and DC bus voltage exceeds the dEb return level, the drive linearly decelerates to 0Hz and stops. The keypad displays the “dEb” warning until you manually reset it, so you can see the reason for the stop.



Situation 2:

Momentary power loss, or too low and unstable power voltage, or power supply sliding down because of sudden heavy load. P07.13 = 2 and power recovers.

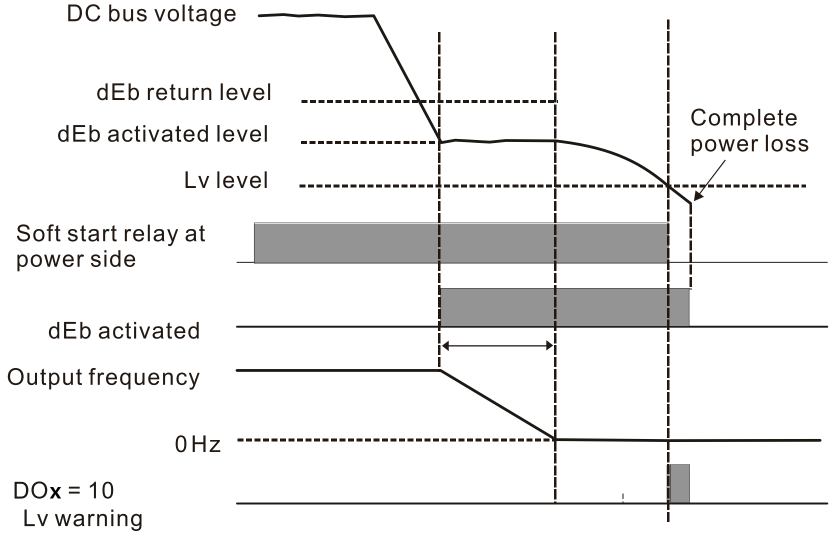
During the dEb deceleration (includes 0Hz run), if the power recovers to a voltage higher than dEb return level, the drive maintains the frequency for three seconds and then accelerates again. The “dEb” warning on the keypad is automatically cleared.



Situation 3:

Unexpected power shut down or power loss. P07.13 = 1 and power does not recover.

The keypad displays the “dEb” warning and the drive stops after decelerating to the lowest operating frequency. When the DC bus voltage is lower than the Lv level, the drive disconnects the soft start relay until the power completely runs out.



Situation 4:

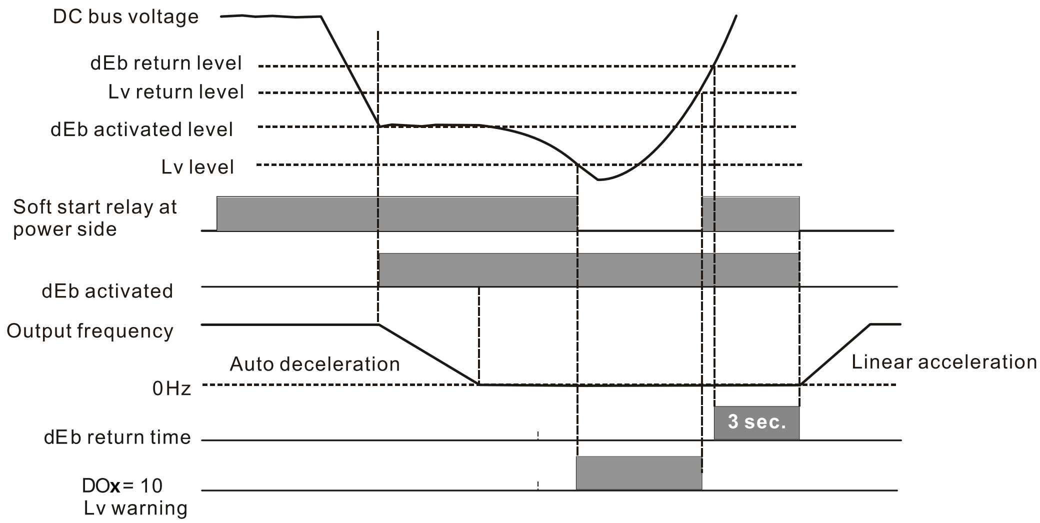
Unexpected power shut down or power loss. P07.13 = 2 and power does not recover.

The drive decelerates to 0Hz. The DC bus voltage continues to decrease until the voltage is lower than the Lv level, and then the drive disconnects the soft start relay. The keypad displays “dEb” warning until the drive completely runs out of power.

Situation 5:

P07.13 = 2 and power recovers after the DC bus voltage is lower than the Lv level.

The drive decelerates to 0Hz. The DC bus voltage continues to decrease until the voltage is lower than the Lv level, and then the drive disconnects the soft start relay. The soft start relay closes again after the power recovers and the DC bus voltage is higher than the Lv return level. When the DC bus voltage is higher than the dEb return level, the drive maintains the frequency for three seconds and starts to accelerate linearly. The "dEb" warning on the keypad is automatically cleared.



		Type	Hex Addr	Dec Addr
P07.15	***Dwell Time at Acceleration***	♦R/W	070F	41808
P07.17	***Dwell Time at Deceleration***	♦R/W	0711	41810

Range/Units (Format: 16-bit unsigned) — *Default*

0.00–600.0 sec — 0.00

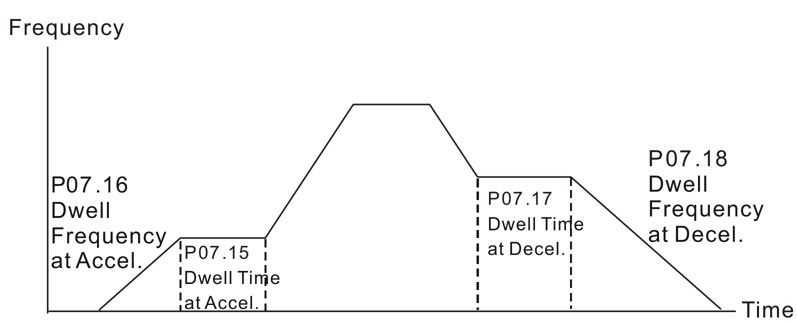
		Type	Hex Addr	Dec Addr
P07.16	***Dwell Frequency at Acceleration***	♦R/W	0710	41809
P07.18	***Dwell Frequency at Deceleration***	♦R/W	0712	41811

Range/Units (Format: 16-bit unsigned) — *Default*

0.00–599.0 Hz — 0.00

In constant torque situations, the Dwell temporarily maintains stable output frequency. Use this parameter for cranes, elevators, and so on.

For constant torque applications, use P07.15–P07.18 to avoid OV or OC protection.



Dwell at accel./decel.

		Type	Hex Addr	Dec Addr
P07.19	***Fan Cooling Control***	♦R/W	0713	41812
	Range/Units (Format: 16-bit binary)	*Default*		

0: Fan is always ON — Default: 3
1: Fan is OFF after the AC motor drive stops for one minute.
2: Fan is ON when the AC motor drive runs; fan is OFF when the AC motor drive stops
3: Fan turns ON when the temperature (IGBT) reaches around 60°C.
5: Fan turns ON/OFF when the AC motor drive runs/stops and stops at zero speed.

Use P07.19 to control the fan.

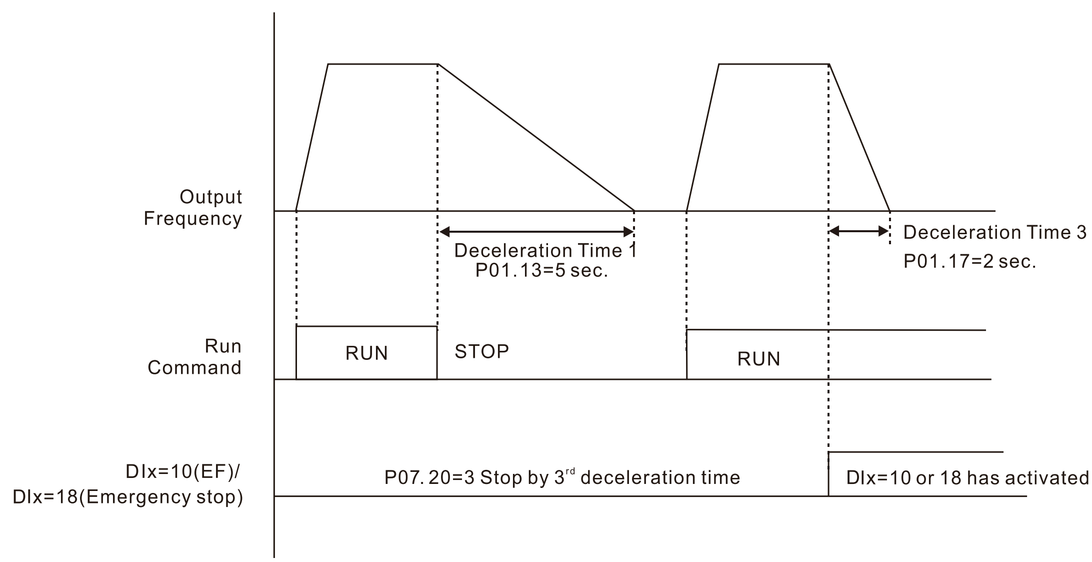
- *P07.19 = 0: Fan runs immediately when the drive power is turned ON.*
- *P07.19 = 1: Fan runs when the AC motor drive runs. One minute after the AC motor drive stops, the fan is OFF.*
- *P07.19 = 2: Fan runs when the AC motor drive runs and stops immediately when the AC motor drive stops.*
- *P07.19 = 3: When temperature of the IGBT or capacitors is higher than 60°C, the fan runs. When both the temperature of the IGBT and capacitors are lower than 40°C, the fan stops.*

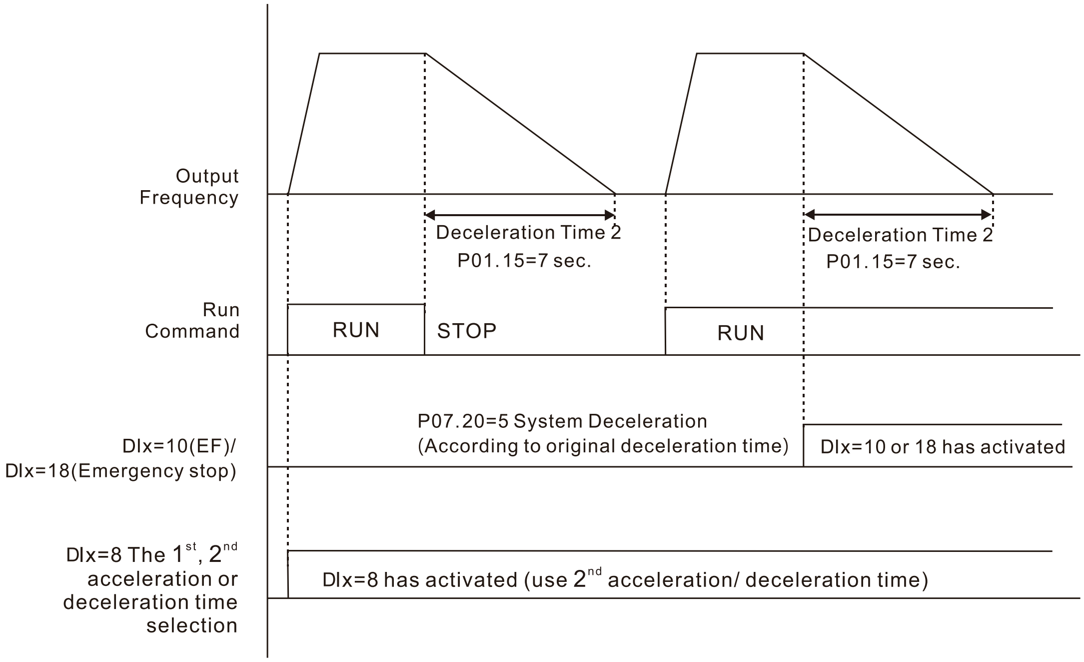
		Type	Hex Addr	Dec Addr
P07.20	***Emergency Stop (EF) & Force to Stop Selection***	♦R/W	0714	41813
	Range/Units (Format: 16-bit binary)	*Default*		

0: Coast to stop — Default: 0
1: Stop by the first deceleration time
2: Stop by the second deceleration time
3: Stop by the third deceleration time
4: Stop by the fourth deceleration time
5: System deceleration
6: Automatic deceleration

When the multi-function input terminal setting is set to 10 (EF input) or 18 (force to stop) and the terminal contact is ON, the drive stops according to the setting of this parameter.

- *When P07.20=5 (system deceleration), the EF deceleration behavior will follow P01.44 setting. If P01.44=0 or 1 & P07.20=5. when EF is ON, the deceleration will be Linear. If P01.44=2 or 3 & P07.20=5, when EF is ON, the deceleration will be Auto deceleration.*
- *When P07.20=6 (auto deceleration), the drive automatically determines the loaded regenerative energy to steadily and smoothly stop the motor in the fastest deceleration time.*





		Type	Hex Addr	Dec Addr
P07.21	***Automatic Energy-saving Setting***	♦R/W	0715	41814
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable	0		
	1: Enable			

When energy-saving is enabled, the motor acceleration/deceleration operates with full voltage. During constant speed operation, it automatically calculates the best voltage value according to the load power. This function is not suitable for fluctuating loads or loads which are nearly full during operation.

When the output frequency is constant (that is, constant operation), the output voltage decreases automatically as the load decreases. Therefore, the drive operates with minimum multiplication of voltage and current (electric power) to reach the energy-saving.

		Type	Hex Addr	Dec Addr
P07.23	***Automatic Voltage Regulation (AVR) Function***	♦R/W	0717	41816
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Enable AVR 1: Disable AVR 2: Disable AVR during deceleration	0		

The rated voltage of a 220V motor is usually 200VAC, 60Hz / 50Hz, and the input voltage of the AC motor drive may vary from 180–264 VAC, 50Hz / 60Hz. Therefore, when the AC motor drive is used without the AVR function, the output voltage is the same as the input voltage. When the motor runs at the voltage exceeding 12–20% of the rated voltage, it causes higher temperatures, damaged insulation, and unstable torque output, which result in shortened motor lifetime.

The AVR function automatically regulates the output voltage of the AC motor drive to the motor's rated voltage when the input voltage exceeds the motor's rated voltage. For example, if the V/F curve is set at 200VAC, 50Hz and the input voltage is at 200–264 VAC, then the drive automatically reduces the output voltage to the motor to a maximum of 200VAC, 50Hz. If the input voltage is at 180–200 VAC, the output voltage to motor is in direct proportion to the input voltage.

- *P07.23 = 0: When the AVR function is enabled, the drive calculates the output voltage according to the actual DC bus voltage. The output voltage does NOT change when the DC bus voltage changes.*
- *P07.23 = 1: When the AVR function is disabled, the drive calculates the output voltage according to the actual DC bus voltage. The output voltage changes with the DC bus voltage, and may cause insufficient current, over-current or oscillation.*
- *P07.23 = 2: The drive disables the AVR function only during deceleration to stop, and at this time, you can accelerate the braking to achieve the same result.*

When the motor ramps to stop, disable the AVR function to shorten the deceleration time. Then, use with the auto-acceleration and auto-deceleration functions to make the motor's deceleration faster and more stable.

AVR applies to all control modes (P00.11). Refer to page 4–52 for function block diagrams of AVR in the drive control loop.

		Type	Hex Addr	Dec Addr
P07.24	***Torque Command Filter Time (V/F and SVC Control Mode)***	♦R/W	0718	41817
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.001–10.000 sec.	0.050		

When the time constant setting is too large, the control is stable but the control response is slow. When the time constant setting is too small, the control response is faster but the control may be unstable. For optimal setting, adjust the setting based on the control stability or the control response.

		Type	Hex Addr	Dec Addr
P07.25	***Slip Compensation Filter Time (V/F and IMSVC Control Mode)***	♦R/W	0719	41818
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.001–10.000 sec.	0.100		

Change the compensation response time with P07.24 and P07.25.

If you set P07.24 and P07.25 to 10 seconds, the compensation response time is the slowest; however, the system may be unstable if you set the time too short.

P07.25 is only used for V/F mode (P00.11=0) and IM-SVC mode (P00.11=2). See function block diagram under P00.11 on page 4–52.

		Type	Hex Addr	Dec Addr
P07.26	***Torque Compensation Gain (Motor 1)***	♦R/W	071A	41819
P07.71	***Torque Compensation Gain (Motor 2)***	♦R/W	0747	41864

Range/Units (Format: 16-bit unsigned)	*Default*
IM: 0–10 (when P05.33=0) PM: 0–5000 (when P05.33=1 or 2)	1

These parameters apply to P00.11 V/F and SVC control modes.

With a large motor load, a part of the drive output voltage is absorbed by the stator winding resistor; therefore, the air gap magnetic field is insufficient. This causes insufficient voltage at motor induction and results in excessive output current but insufficient output torque. Auto-torque compensation can automatically adjust the output voltage according to the load and keep the air gap magnetic fields stable to get the optimal operation.

In the V/F control, the voltage decreases in direct proportion with decreasing frequency. The torque decreases at low speed because of a decreasing AC resistor and an unchanged DC resistor. The auto-torque compensation function increases the output voltage at low frequency to get a higher starting torque.

When the compensation gain is set too high, it may cause motor over-flux and result in a too great an output current from the drive, motor overheating or trigger the drive's protection function.

See function block diagrams under P00.11 on page 4–52.

		Type	Hex Addr	Dec Addr
P07.27	***Slip Compensation Gain (Motor 1)***	♦R/W	071B	41820
P07.72	***Slip Compensation Gain (Motor 2)***	♦R/W	0748	41865

Range/Units (Format: 16-bit unsigned)	*Default*
0.00–10.00	0.00 (1 in SVC mode)

These parameters apply to P00.11 V/F and SVC control modes.

The induction motor needs constant slip to produce electromagnetic torque. It can be ignored at higher motor speeds, such as rated speed or 2–3% of slip.

However, during the drive operation, the slip and the synchronous frequency are in reverse proportion to produce the same electromagnetic torque. The slip is larger with the reduction of the synchronous frequency. Moreover, the motor may stop when the synchronous frequency decreases to a specific value. Therefore, the slip seriously affects the motor speed accuracy at low speed.

In another situation, when you use an induction motor with the drive, the slip increases when the load increases. It also affects the motor speed accuracy.

Use this parameter to set the compensation frequency, and reduce the slip to maintain the synchronous speed when the motor runs at the rated current in order to improve the accuracy of the drive. When the drive output current is higher than P05.05 (No-load Current for Induction Motor 1 (A)), the drive compensates the frequency according to this parameter.

This parameter is set to 1.00 automatically when P00.11 (Speed Control Mode) is changed from V/F mode to vector mode. Otherwise, it is automatically set to 0.00. Apply the slip compensation after load and acceleration. Increase the compensation value from small to large gradually; add the output frequency to the [motor rated slip x P07.27 (Slip Compensation Gain)] when the motor is at the rated load. If the actual speed ratio is slower than expected, increase the parameter setting value; otherwise, decrease the setting value.

See function block diagrams under P00.11 on page 4–52.

		Type	Hex Addr	Dec Addr
P07.29	***Slip Deviation Level***	♦R/W	071D	41822
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–100.0% 0: No detection	0		

		Type	Hex Addr	Dec Addr
P07.30	***Over-slip Deviation Detection Time***	♦R/W	071E	41823
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–10.0 sec.	1.0		

		Type	Hex Addr	Dec Addr
P07.31	***Over-slip Deviation Treatment***	♦R/W	071F	41824
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning	0		

P07.29–P07.31 set the allowable slip level/time and the over-slip treatment when the drive is running.

		Type	Hex Addr	Dec Addr
P07.32	***Motor Oscillation Compensation Factor***	♦R/W	0720	41825
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–10000	1000		

If there are current wave motions which cause severe motor oscillation in some specific area, setting P07.32 can effectively improve this situation. (When running with high frequency or PG, set this parameter to 0. When the current wave motion occurs in low frequency and high power, increase the value for P07.32.)

		Type	Hex Addr	Dec Addr
P07.33	***Auto-restart Interval of Fault***	♦R/W	0721	41826
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–6000 sec.	60.0		

When a reset/restart occurs after a fault, the drive uses P07.33 as a timer and starts counting the number of faults within this time period. Within this period, if the number of faults does not exceed the setting for P07.11, the counting clears and starts from 0 when the next fault occurs.

		Type	Hex Addr	Dec Addr
P07.38	***PMSVC Voltage Feed Forward Gain***	R/W	0726	41831
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.50–2.00	1.00		

Adjusts the PMSVC voltage feedback forward gain to meet the demands of rapid feedback applications.

- *P07.38=1.00 sets forward feedback = Ke x motor rotor speed.*
- *Refer to PMSVC Adjustment section for details.*

		Type	Hex Addr	Dec Addr
P07.62	***dEb Gain (Kp)***	♦R/W	073E	41855
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–65535	8000		

		Type	Hex Addr	Dec Addr
P07.63	***dEb Gain (Ki)***	♦R/W	073F	41856
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–65535	150		

These parameters set the PI gain of DC bus voltage controller when the dEb function activates.

If the DC bus voltage drops too fast, or the speed oscillation occurs during deceleration after the dEb function activates, adjust P07.62 and P07.63. Increase the Kp setting to quicken the control response, but oscillation may occur if the setting is too large. Use Ki parameter to decrease the steady-state error to zero, and increase the setting to quicken the response speed.

		Type	Hex Addr	Dec Addr
P07.84	***Flying Catch Retry Time***	♦R/W	0754	41877
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–65535	0		

During speed tracking, the motor drive free runs when DC bus voltage reaches OV stall level, and it will do flying catch again after P07.84 setting time.

		Type	Hex Addr	Dec Addr
P07.85	***Magnetization Time***	♦R/W	0755	41878
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–65535	0		

Tune P07.85 according to different motors to increase the detection accuracy of initial angle for a better flying catch performance.

Group P08.xx Details – High-function PID Parameters

		Type	Hex Addr	Dec Addr
P08.00	***Terminal Selection of PID Feedback***	♦R/W	0800	42049
	Range/Units (Format: 16-bit binary)	Default		
	0: No function 1: Negative PID feedback: by analog input (P03.00) 4: Positive PID feedback: by analog input (P03.00) 7: Negative PID feedback: by communication protocols 8: Positive PID feedback: by communication protocols	0		

Negative feedback:

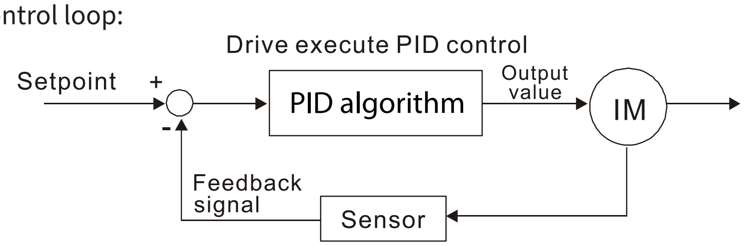
Error = + Target value (set point) – Feedback. Use negative feedback when the detection value increases if the output frequency increases.

Positive feedback:

Error = Target value (set point)+ Feedback. Use positive feedback when the detection value decreases if the output frequency increases.

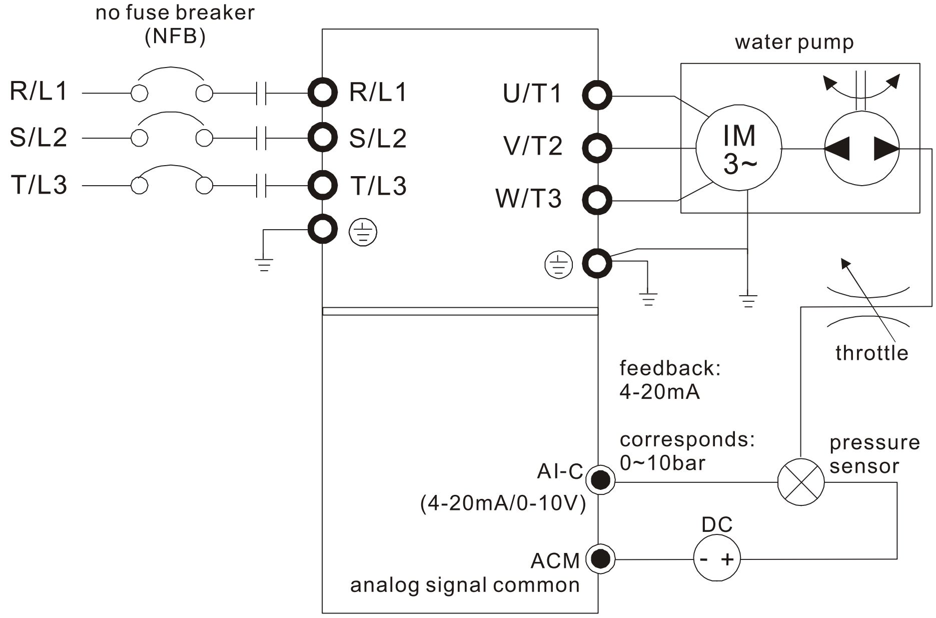
When P08.00 ≠ 7 or ≠ 8, the input value is disabled. The setting value does not remain when the drive is powered off.

1) Common applications for PID control:
   a) Flow control: Use a flow sensor to feedback the flow data and perform accurate flow control.
   b) Pressure control: Use a pressure sensor to feedback the pressure data and perform precise pressure control.
   c) Air volume control: Use an air volume sensor to feedback the air volume data to achieve excellent air volume regulation.
   d) Temperature control: Use a thermocouple or thermistor to feedback temperature data for comfortable temperature control.
   e) Speed control: Use a speed sensor to feedback motor shaft speed or input another machine speed as a target value for synchronous control.
2) PID control loop:



3) Concept of PID control:
   a) Proportional gain (P): The output is proportional to input. With only a proportional gain control, there is always a steady-state error.
   b) Integral time (I): The controller output is proportional to the integral of the controller input. When an automatic control system is in a steady state and a steady-state error occurs, the system is called a System with Steady-state Error. To eliminate the steady-state error, add an “integral part” to the controller. The integral time controls the relation between the integral part and the error. The integral part increases over time even if the error is small. It gradually increases the controller output to eliminate the error until it is zero. This stabilizes the system without a steady-state error by using proportional gain control and integral time control.
   c) Differential control (D): The controller output is proportional to the differential of the controller input. During elimination of the error, oscillation or instability may occur. Use the differential control to suppress these effects by acting before the error. That is, when the error is near 0, the differential control should be 0. Use proportional gain (P) and differential control (D) to improve the system state during PID adjustment.

4) Using PID control in a constant pressure pump feedback application:
Set the application's constant pressure value (bar) to be the set point of PID control. The pressure sensor sends the actual value as the PID feedback value. After comparing the PID set point and PID feedback, an error displays. The PID controller calculates the output by using proportional gain (P), integral time (I) and differential time (D) to control the pump. It controls the drive to use a different pump speed and achieves constant pressure control by using a 4–20 mA signal corresponding to 0–10 bar as feedback to the drive.



- *P00.04 = 10 (display PID feedback (b) (%))*
- *P01.12 Acceleration Time is set according to actual conditions.*
- *P01.13 Deceleration Time is set according to actual conditions.*
- *P00.21 = 0, operate through the digital keypad*
- *P00.20 = 0, the digital keypad controls the set point.*
- *P08.00 = 1 (negative PID feedback from analog input)*
- *AI-C analog input P03.00 = 5, PID feedback signal.*
- *P08.01-P08.03 is set according to actual conditions.*
- *If there is no oscillation in the system, increase P08.01 (Proportional Gain (P))*
- *If there is no oscillation in the system, decrease P08.02 (Integral Time (I))*
- *If there is no oscillation in the system, increase P08.03 (Differential Time (D))*
- *Refer to P08.00–P08.21 for PID parameter settings.*

		Type	Hex Addr	Dec Addr
P08.01	***Proportional Gain (P)***	♦R/W	0801	42050
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–1000.0 (When P08.23 bit 1 = 0) 0.00–100.00 (When P08.23 bit 1 = 1)	1.00		

Sets the proportional gain to determine the deviation response speed. The higher the proportional gain, the faster the response speed. Eliminates the system deviation; usually used to decrease the deviation and get faster response speed. If you set the value too high, overshoot occurs and it may cause system oscillation and instability.

When P08.01 = 1.0: Kp gain is 100%; if the setting is 0.5, Kp gain is 50%.

If you set the other two gains (I and D) to zero, proportional control is the only effective parameter.

		Type	Hex Addr	Dec Addr
P08.02	***Integral Time (I)***	♦R/W	0802	42051
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–100.00 sec.	1.00		

Use the integral controller to eliminate deviation during stable system operation. The integral control does not stop working until the deviation is zero. The integral is affected by the integral time. The smaller the integral time, the stronger the integral action. It is helpful to reduce overshoot and oscillation for a stable system. Accordingly, the speed to lower the steady-state deviation decreases. Integral control is often used with the other two controls for the PI controller or PID controller.

Sets the integral time of the I controller. When the integral time is long, there is a small I controller gain, with slower response and slow external control. When the integral time is short, there is a large I controller gain, with faster response and rapid external control.

- *When the integral time is too short, it may cause overshoot or oscillation for the output frequency and system.*
- *Set Integral Time to 0.00 to disable the I controller.*

		Type	Hex Addr	Dec Addr
P08.03	***Differential Time (D)***	♦R/W	0803	42052
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–1.00 sec.	0.00		

Use the differential controller to show the system deviation change, as well as to preview the change in the deviation. You can use the differential controller to eliminate the deviation in order to improve the system state. Using a suitable differential time can reduce overshoot and shorten adjustment time; however, the differential operation increases noise interference. Note that a too large differential causes more noise interference. In addition, the differential shows the change and the differential output is 0 when there is no change. Note that you cannot use the differential control independently. You must use it with the other two controllers for the PD controller or PID controller.

Sets the D controller gain to determine the deviation change response. Using a suitable differential time reduces the P and I controllers overshoot to decrease the oscillation for a stable system. A differential time that is too long may cause system oscillation.

The differential controller acts on the change in the deviation and cannot reduce interference. Do not use this function when there is significant interference.

		Type	Hex Addr	Dec Addr
P08.04	***Upper Limit of Integral Control***	♦R/W	0804	42053
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–100.0%	100.0		

P08.04 defines an upper bound for the integral gain (I) and therefore limits the master frequency.

The formula is: Integral upper bound = Maximum Operation Frequency (P01.00) x (P08.04%).

An excessive integral value causes a slow response due to sudden load changes and may cause motor stall or machine damage. If so, decrease it to a proper value.

		Type	Hex Addr	Dec Addr
P08.05	***PID Output Command Limit (Positive Limit)***	♦R/W	0805	42054
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–110.0%	100.0		

P08.05 defines the percentage of the output frequency limit during the PID control. The formula is Output Frequency Limit = Maximum Operation Frequency (P01.00) × P08.05%.

		Type	Hex Addr	Dec Addr
P08.06	***PID Feedback Value by Communication Protocol***	♦R/W	0806	42055
	Range/Units (Format: 16-bit signed)	*Default*		
	-200.00–200.00%	0.00		

Use communications to set the PID feedback value when the PID feedback input is set to communications (P08.00 = 7 or 8).

		Type	Hex Addr	Dec Addr
P08.07	***PID Delay Time***	♦R/W	0807	42056
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–2.5 sec.	0.0		

P08.07 determines the primary low pass filter time when in PID control. Setting a large time constant may slow down the drive’s response speed.

PID control output frequency is filtered with a primary low pass function. This function can filter a mix of frequencies. A long primary low pass time means the filter degree is high and a short primary low pass time means the filter degree is low.

Inappropriate delay time setting may cause system oscillation.

		Type	Hex Addr	Dec Addr
P08.08	***Feedback Signal Detection Time***	♦R/W	0808	42057
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–3600.0 sec.	0.0		

Valid only when the feedback signal is AI-C (P03.28 = 2, 4-20mA).

P08.08 sets the detection time for abnormal PID signal feedback. You can also use it when the system feedback signal response is extremely slow. (Setting the detection time to 0.0 disables the detection function.)

		Type	Hex Addr	Dec Addr
P08.09	**Feedback Signal Fault Treatment**	♦R/W	0809	42058

Range/Units (Format: 16-bit binary) — Default: 0

0: Warn and continue operation
1: Fault and ramp to stop
2: Fault and coast to stop
3: Warn and operate at last frequency

Valid only when the feedback signal is AI-C (4–20 mA).

Sets the treatments when the PID feedback signal is abnormal.

		Type	Hex Addr	Dec Addr
P08.10	**Sleep Frequency**	♦R/W	080A	42059

Range/Units (Format: 16-bit unsigned) — Default: 0.00

0.00–599.0 Hz (P08.18=0)
0.00–200.00% (P08.18=1)

P08.10 determines the sleep frequency, and if the sleep time and the wake-up frequency are enabled or disabled.

- *P08.10 = 0: Disabled*
- *P08.10 ≠ 0: Enabled*

		Type	Hex Addr	Dec Addr
P08.11	**Wake-up Frequency**	♦R/W	080B	42060

Range/Units (Format: 16-bit unsigned) — Default: 0.00

0.00–599.0 Hz (P08.18=0)
0.00–200.00% (P08.18=1)

When P08.18=0, the unit for P08.10 and that for P08.11 switch to frequency. The settings are between 0.00–599.0 Hz.

When P08.18=1, the unit for P08.10 and that for P08.11 switch to percentage. The settings are between 0.00–200.00%.

- *The percentage is based on the current setpoint value, not the maximum value. For example, if the maximum value is 100kg, and the current setpoint value is 30kg, then if P08.11=40%, the value is 12kg.*
- *P08.10 uses the same logic for calculation.*

		Type	Hex Addr	Dec Addr
P08.12	**Sleep Time**	♦R/W	080C	42061

Range/Units (Format: 16-bit unsigned) — Default: 0.0

0.0–6000 sec.

When the Frequency command is smaller than the sleep frequency and less than the sleep time, the Frequency command is equal to the sleep frequency. However, the Frequency command remains at 0.00 Hz until the Frequency command becomes equal to or larger than the wake-up frequency.

		Type	Hex Addr	Dec Addr
P08.13	**PID Feedback Signal Error Deviation Level**	♦R/W	080D	42062

Range/Units (Format: 16-bit unsigned) — Default: 10.0

1.0–50.0%

		Type	Hex Addr	Dec Addr
P08.14	***PID Feedback Signal Error Deviation Detection Time***	♦R/W	080E	42063
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.1–300.0 sec.	5.0		

When the PID control function is normal, it should calculate the value within a period of time that is close to the target value.

Refer to the PID control diagram for details. When executing PID feedback control, if |PID reference target value - detection value| > P08.13 PID Feedback Signal Error Deviation Level and time exceeds P08.14 setting, it is regarded as a PID control fault, and the multi-function output terminal setting 15 (PID feedback error) activates.

		Type	Hex Addr	Dec Addr
P08.15	***PID Feedback Signal Filter Time***	♦R/W	080F	42064
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.1–300.0 sec.	5.0		

		Type	Hex Addr	Dec Addr
P08.16	***PID Compensation Selection***	♦R/W	0810	42065
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Parameter setting 1: Analog input	0		

When P08.16=0: the setting for P08.17 determines the PID compensation value.

		Type	Hex Addr	Dec Addr
P08.17	***PID Compensation***	♦R/W	0811	42066
	Range/Units (Format: 16-bit signed)	*Default*		
	-100.0–100.0%	0		

The PID compensation value = maximum PID target value × P08.17.

Example:

If the maximum operation frequency P01.00 = 60Hz, and P08.17 = 10.0%, the PID compensation value increases the output frequency 6.00 Hz (60.00 Hz × 100.00% × 10.0% = 6.00 Hz).

		Type	Hex Addr	Dec Addr
P08.18	***Sleep Mode Function Setting***	R/W	0812	42067
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Refer to PID output command 1: Refer to PID feedback signal	0		

P08.18 determines the setting type for P08.10 and P08.11.

- *P08.18 = 0: The unit for P08.10 and P08.11 switch to frequency. The settings are between 0.00–599.0 Hz.*
- *P08.18 = 1: The unit for P08.10 and P08.11 switch to percentage. The settings are between 0.00–200.00%.*

		Type	Hex Addr	Dec Addr
P08.19	***Wake-up Integral Limit***	♦R/W	0813	42068
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–200.0%	50.0		

P08.19 reduces the reaction time from sleep to wake-up.

Defines the wake-up integral frequency limit = (P01.00 × P08.19%)

		Type	Hex Addr	Dec Addr
P08.20	***PID Mode Selection***	R/W	0814	42069
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Dependent ISA PID structure 1: Independent/Parallel PID structure	0		

- *P08.20 = 0: Use Dependent (ISA) PID control structure (Kp, Kp*Ki, Kp*Kd).*
- *P08.20 = 1: Use Independent/Parallel PID control structure. The proportional gain, integral gain, and differential gain are independent (Kp, Ki, Kd). You can customize the P, I, and D value to fit your application.*

PI Control:

Controlled only by the P action, so the deviation cannot be entirely eliminated. In general, to eliminate residual deviations, use the P + I controls. When you use the PI control, it eliminates the deviation caused by the targeted value changes and the constant external interferences. However, if the I action is too powerful, it delays the response when there is rapid variation. You can use the P action by itself to control the loading system with the integral components.

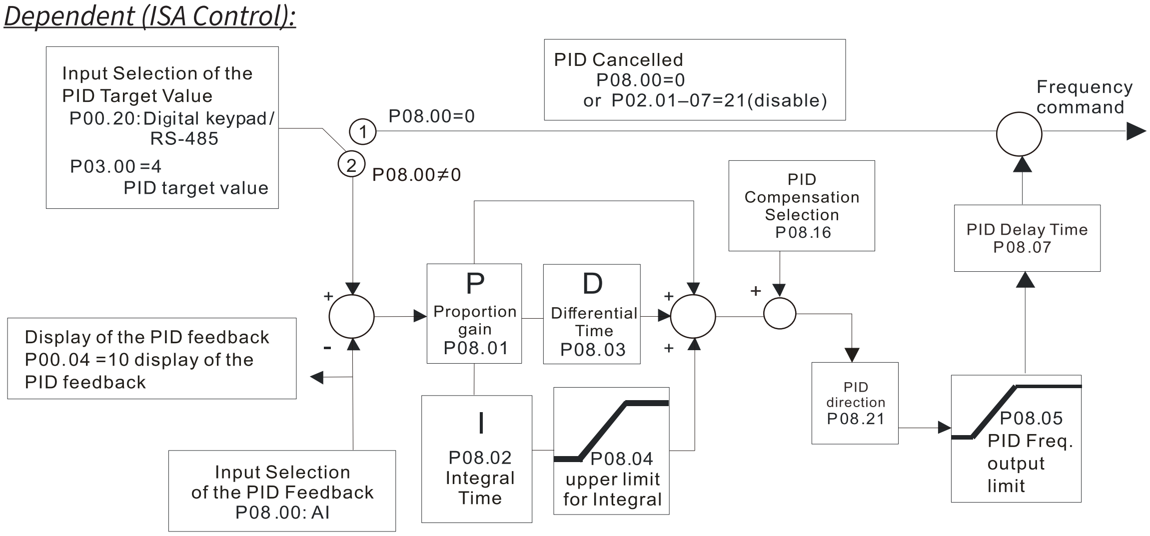
PD Control:

When deviation occurs, the system immediately generates an operation load that is greater than the load generated only by the D action to restrain the deviation increment. If the deviation is small, the effectiveness of the P action decreases as well. The control objects include applications with integral component loads, which are controlled by the P action only. Sometimes, if the integral component is functioning, the whole system may oscillate. In this case, use the PD control to reduce the P action's oscillation and stabilize the system. In other words, this control is useful with no brake function's loading over the processes.

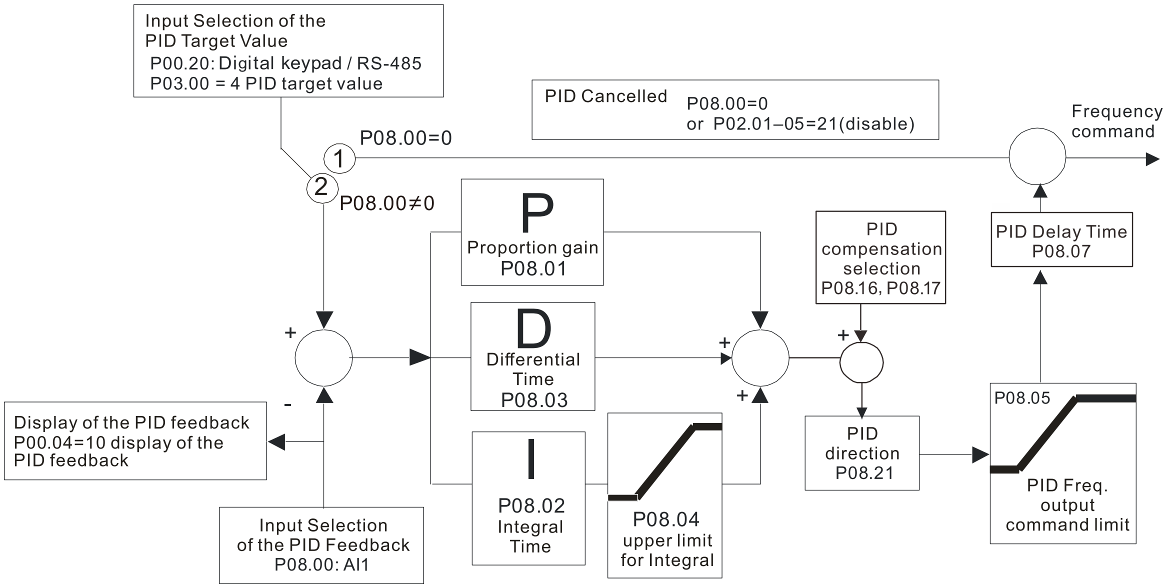
PID Control:

Use the I action to eliminate the deviation and the D action to reduce oscillation; then combine this with the P action for the PID control. Use the PID method for a control process with no deviations, high accuracy, and a stable system.

Dependent (ISA Control):



Independent (Parallel) control:



		Type	Hex Addr	Dec Addr
P08.21	***Enable PID to Change the Operation Direction***	R/W	0815	42070
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Operation direction cannot be changed	0		
	1: Operation direction can be changed			

		Type	Hex Addr	Dec Addr
P08.22	***Wake-up Delay Time***	♦R/W	0816	42071
	Range/Units (Format: 16-bit binary)	*Default*		
	0.00–600.0 sec.	0.00		

Refer to P08.18 and the diagrams in P08.23 for more information.

		Type	Hex Addr	Dec Addr
P08.23	***PID Control Flag***	♦R/W	0817	42072
	Range/Units (Format: 16-bit binary)	*Default*		
	bit 0 = 1, PID running in reverse follows the setting for P00.23.	2		
	bit 0 = 0, PID running in reverse refers to PID's calculated value.			
	bit 1 = 1, two decimal places for PID Kp			
	bit 1 = 0, one decimal place for PID Kp			

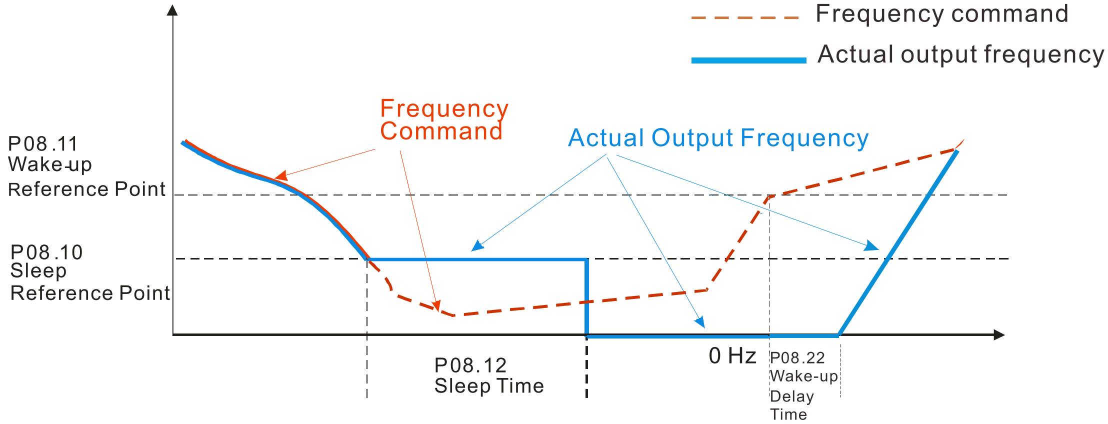
P08.23 sets the PID control flag.

- *P08.23 bit 0 = 1: PID running in reverse function is valid only when P08.21=1.*
- *P08.23 bit 0 = 0: If the PID calculated value is positive, the direction is forward. If the PID calculated value is negative, the direction is reverse.*

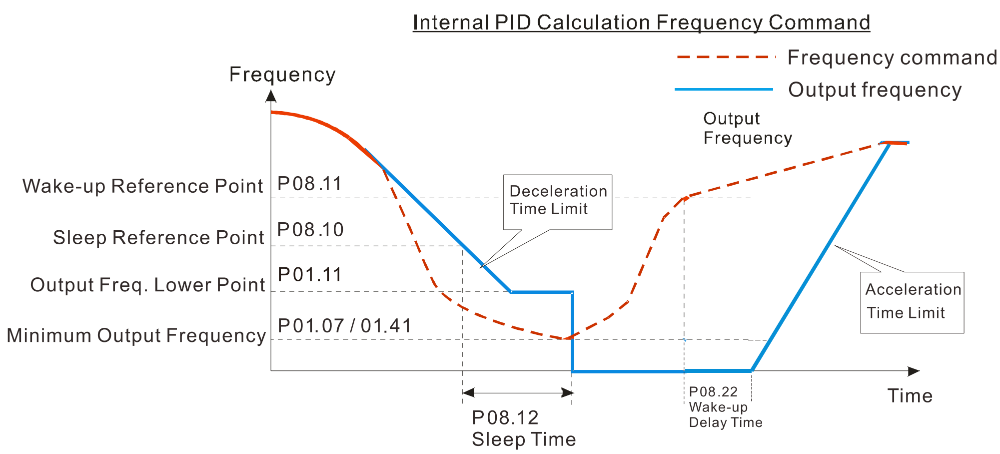
When the bit1 setting changes, the Kp gain does not change. For example: Kp = 6. When P08.23 bit1 = 0, Kp = 6.0; when P08.23 bit1 = 1, Kp = 6.00.

There are three scenarios for the sleep and wake-up frequency.

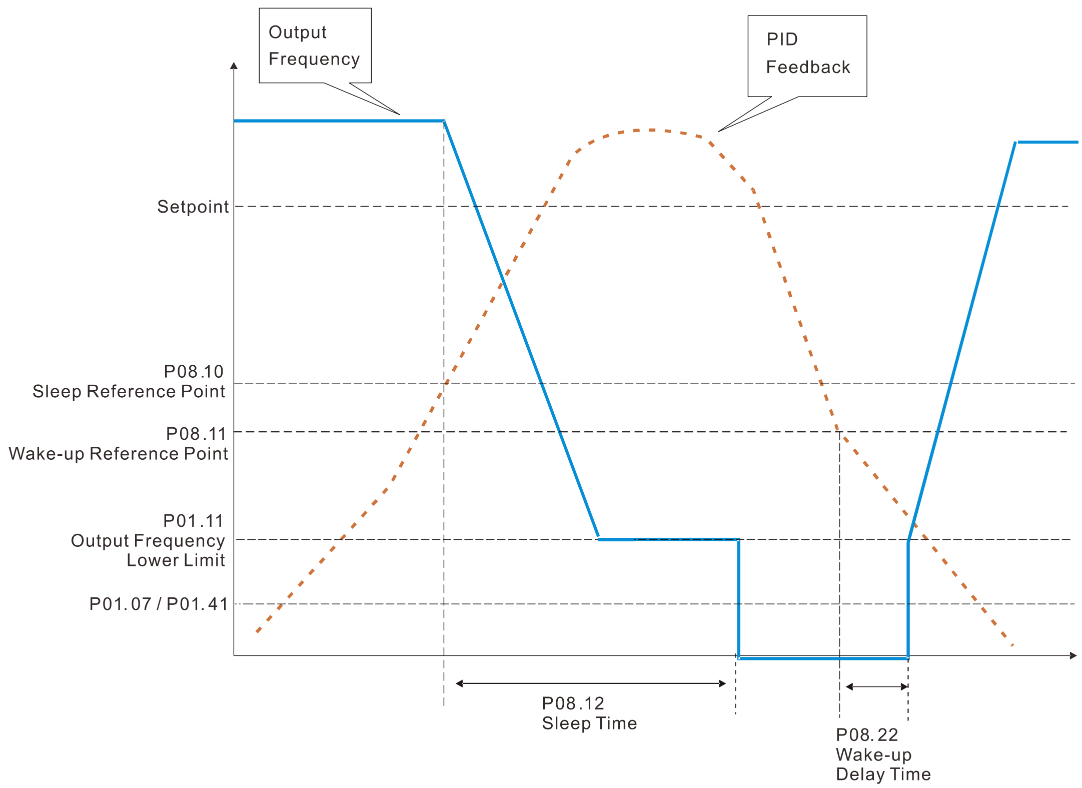
1) Frequency Command (PID is not in use, P08.00 = 0. Works only in V/F mode)
When the output frequency ≤ the sleep frequency and the drive reaches the preset sleep time, then the drive is in sleep mode (0Hz). When the Frequency command reaches the wake-up frequency, the drive starts to count the wake-up delay time. When the drive reaches the wake-up delay time, it starts to catch up to reach the Frequency command value by the acceleration time.



2) Internal PID Calculation Frequency Command (PID is in use, P08.00 ≠ 0 and P08.18=0.)
When the PID calculation Frequency command reaches the sleep frequency, the drive starts to count the sleep time and the output frequency starts to decrease. If the drive exceeds the preset sleep time, then the drive is in sleep mode (0Hz). If the drive does not reach the preset sleep time, it remains at the lower frequency limit (if there is a preset lower limit.), or it remains at the minimum output frequency set for P01.07 and waits until it reaches the sleep time before going into sleep mode (0Hz). When the PID calculated Frequency command reaches the wake-up frequency, the drive starts to count the wake-up delay time. Once it reaches the wake-up delay time, the drive starts to catch up to reach the PID Frequency command value by the acceleration time.



3) PID Feedback Value Percentage (PID is in use, P08.00 ≠ 0 and P08.18 = 1)
When the PID feedback value reaches the sleep level percentage, the drive starts to count the sleep time and the output frequency starts to decrease. If the drive exceeds the preset sleep time, then the drive is in sleep mode (0Hz). If the drive does not reach preset the sleep time, it remains at the lower frequency limit (if there is a preset of lower limit.), or it remains at the minimum output frequency set for P01.07 and waits until it reaches the sleep time before going into sleep mode (0Hz).
When the PID feedback value reaches the wake-up percentage, the drive starts to count the wake-up delay time. Once it reaches the wake-up delay time, the drive starts to catch up to reach the PID Frequency command value by the acceleration time.



		Type	Hex Addr	Dec Addr
P08.26	***PID Output Command Limit (Reverse Limit)***	♦R/W	081A	42075
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–100.0%	100.0		

When PID enables the reverse direction, the PID output is a negative value, and the PID output value is limited by the setting for P08.26. Use this function with P08.21.

		Type	Hex Addr	Dec Addr
P08.27	***Acceleration / Deceleration Time for PID Command***	♦R/W	081B	42076
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–655.35 sec.	0.00		

When P08.27 = 0.00 seconds: Disables the PID acceleration/deceleration command, and the target value is equal to the PID command.

When P08.27 ≠ 0.00 seconds: Enables the PID acceleration/deceleration command. For PID acceleration and deceleration, when the PID target value changes, the command value increment/decrement is executed according to this parameter.

Example:

If we set P08.27 to 10.00 seconds, when PID target value changes from 0% to 100%, it takes 10 seconds for the PID command to change from 0% to 100%. In a similar way, when PID target value changes from 100% to 0%, it takes 10 seconds for the PID command to change from 100% to 0%.

		Type	Hex Addr	Dec Addr
P08.31	***Proportional gain 2***	♦R/W	081F	42080
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–1000.0 (when P08.23 setting bit 1=0) 0.00–100.00 (when P08.23 setting bit 1=1)	1.00		

		Type	Hex Addr	Dec Addr
P08.32	***Integral time 2***	♦R/W	0820	42081
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–100.00 sec.	1.00		

		Type	Hex Addr	Dec Addr
P08.33	***Differential time 2***	♦R/W	0821	42082
	Range/Units (Format: 16-bit binary)	*Default*		
	0.00–1.00 sec.	0.00		

		Type	Hex Addr	Dec Addr
P08.61	***Feedback of PID Physical Quantity Value***	R/W	083D	42110
	Range/Units (Format: 16-bit unsigned)	*Default*		
	1.0–99.9	99.9		

		Type	Hex Addr	Dec Addr
P08.62	***Treatment of the Erroneous PID Deviation Level***	R/W	083E	42111
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0: Warn and keep operating (no treatment) 1: Fault and coast to stop 2: Fault and ramp to stop 3: Ramp to stop and restart after time set at P08.63 (without displaying fault and warning) 4: Ramp to stop and restart after time set at P08.63. The number of restart times depends on the setting for P08.64.	0		

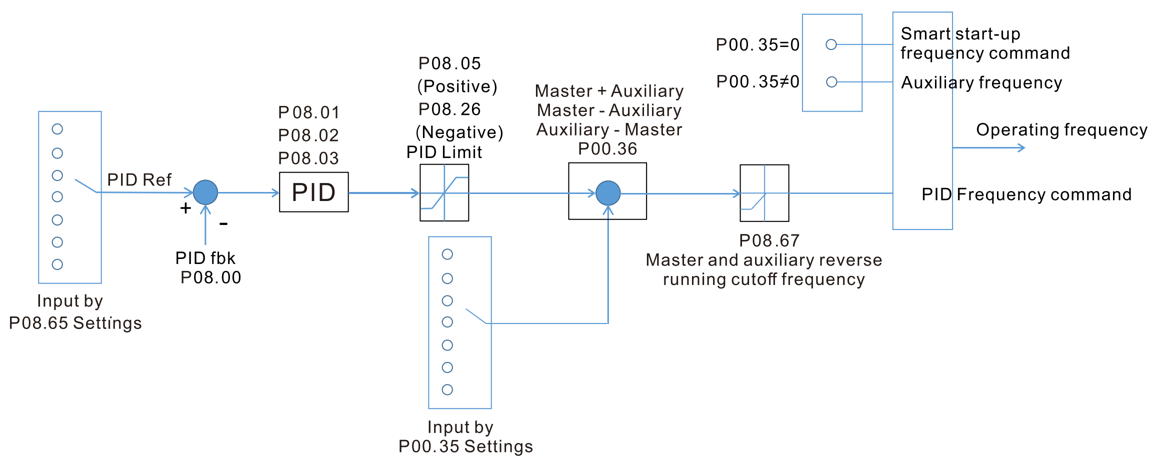
		Type	Hex Addr	Dec Addr
P08.63	***Delay Time for Restart of Erroneous PID Deviation Level***	R/W	083F	42112
	Range/Units (Format: 16-bit binary)	*Default*		
	1–9999 seconds	60		

		Type	Hex Addr	Dec Addr
P08.64	***Number of Times of Restart after PID Error***	♦R/W	0840	42113
	Range/Units (Format: 16-bit binary)	*Default*		
	0–1000 times	0		

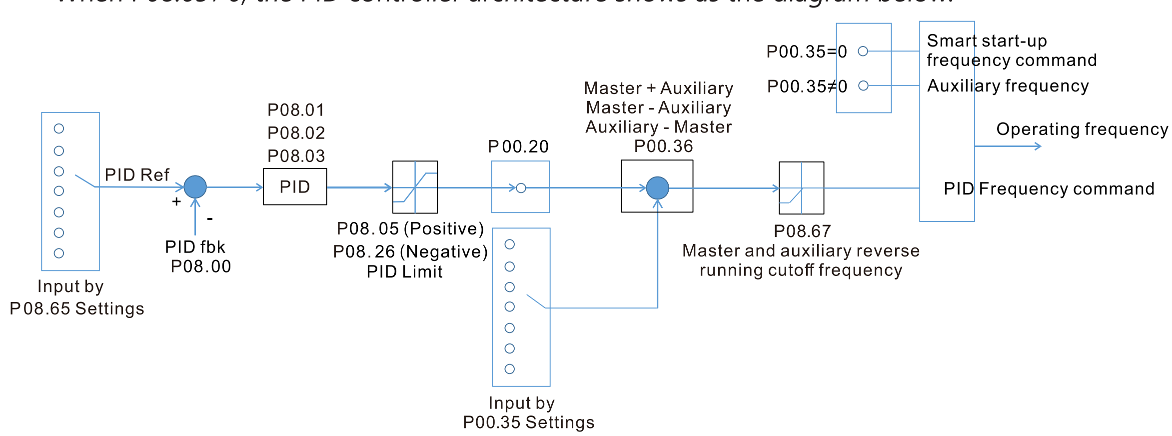
		Type	Hex Addr	Dec Addr
P08.65	***PID Target Value Source***	♦R/W	0841	42114
	Range/Units (Format: 16-bit binary)	Default		
	0: Frequency command (P00.20, P00.30) 1: P08.66 setting 2: RS-485 communication input 3: External analog input (refer to P03.00) 7: Digital keypad VR/Potentiometer dial	0		

P08.65 selects the target value source for the PID controller.

- *When P08.65=0, the maximum operating frequency P01.00 is 60Hz, the error is 100%, and P08.01=1.00, then the output frequency is "1" times the P01.00 maximum operating frequency. Therefore, the output frequency = 60 * 100% * 1=60Hz.*
  *Calculation formula: Output frequency=Fmax (P01.00) * error% ((PID reference value (P00.20 / P00.30) – PID feedback (P08.00)) * P08.01.*
- *When P08.65≠0, the internal calculation of the proportional gain reduces by 100 times, that is, when P01.00 Fmax=60Hz, error=100%, P08.01=1.00, then the output frequency is "0.01" times the P01.00 Fmax. Therefore, the output frequency=60 * 100% * 0.01=0.6 Hz.*
  *Calculation formula: Output frequency=Fmax (P01.00) * error% ((PID reference value (P08.66) – PID feedback value (P08.00)) * P08.01 * 0.01.*
- *When P08.65=0, the PID controller architecture shows as the diagram below:*



- *When P08.65≠0, the PID controller architecture shows as the diagram below:*



- *When P08.65 is not set to 0, P00.20 is automatically set to 9.*
- *When P08.65 is set to 1, set the PID command through P08.66; when P08.65 is not set to 1, P08.66 displays the PID command.*
- *When P08.65 is set to 2, 4, and 6, the corresponding communication address is C2003H.*

		Type	Hex Addr	Dec Addr
P08.66	**PID Target Value Setting**	♦R/W	0842	42115
	Range/Units (Format: 16-bit signed)	Default		
	-100.00–100.00%	50.00		

The target value setting of the PID controller (P08.66) is a relative value.

		Type	Hex Addr	Dec Addr
P08.67	**Master and Auxiliary Reverse Running Cutoff Frequency**	♦R/W	0843	42116
	Range/Units (Format: 16-bit unsigned)	Default		
	0.0–100.0%	10.0		

100% corresponds to P01.00 the maximum operation frequency

In some cases, it is only possible for the PID to control the set point and the feedback to the same status when the PID output frequency is negative (the motor runs in reverse). However, an excessively high reverse frequency is not allowed in some cases, and P08.67 is used to determine the upper limit of the reverse frequency

		Type	Hex Addr	Dec Addr
P08.68	**PID Deviation Limit**	♦R/W	0844	42117
	Range/Units (Format: 16-bit unsigned)	Default		
	0.00–100.00%	0.00		

When P08.68 is not set to 0, the PID deviation limit function is enabled.

When PID deviation ≤ PID deviation limit, PID stops adjusting, which means the PID output frequency maintains the value at last status. This function is effective for some closed-loop control applications.

		Type	Hex Addr	Dec Addr
P08.69	**Integral Separation Level**	♦R/W	0845	42118
	Range/Units (Format: 16-bit unsigned)	Default		
	0.00–100.00%	0.00		

P08.69 reduces overshoot when overshoot occurs in the PID feedback at start-up.

- *When P08.69 is not set to 0, the integral separation function is enabled.*
- *The benchmark for the integral separation level is the PID error%.*
- *The integral separation function activates only once at start-up.*

When PID deviation ≥ P08.69, the integral effect is cancelled to avoid the increasing system overshoot due to the integral effect. When PID deviation is smaller than P08.69, the integral effect is activated to eliminate the steady-state error.

		Type	Hex Addr	Dec Addr
P08.70	**Smart Start-up Level**	R/W	0846	42119
	Range/Units (Format: 16-bit unsigned)	Default		
	0.00–100.00%	5.00		

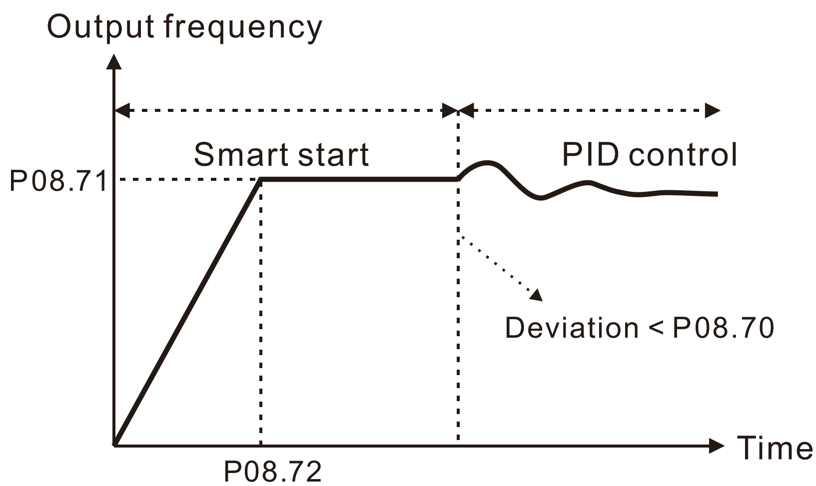
		Type	Hex Addr	Dec Addr
P08.71	**Smart Start-up Frequency Command**	♦R/W	0847	42120
	Range/Units (Format: 16-bit unsigned)	Default		
	0.00–599.0 Hz	0.00		

		Type	*Hex Addr*	*Dec Addr*
P08.72	***Smart Start-up Acceleration Time***	♦R/W	0848	42121
	Range/Units (Format: 16-bit unsigned)	*Default*		
		3.00		

When P08.71 is not set to 0, the smart start-up function is enabled.

- *The benchmark for the smart start-up level is the percentage of PID deviation.*
- *Use the smart start-up function to reduce overshoot when overshoot occurs in the PID feedback at start-up. The smart start-up activates only once at start-up.*

When the smart start-up function is enabled, it starts with the P08.71 frequency and P08.72 acceleration time (P08.72 acceleration time is the time that it accelerates to P08.71). When the PID deviation is smaller than P08.70, it switches to the normal PID control (the smart start-up frequency is filled into the PID integral when switching to PID control to avoid discontinuous frequency).



		Type	*Hex Addr*	*Dec Addr*
P08.75	***PID2 Parameter Switch Condition***	♦R/W	084B	42124
	Range/Units (Format: 16-bit binary)	*Default*		
	0: No switching (refer to P08.01–P08.03) 1: Auto-switch based on the output frequency 2: Auto-switch based on the deviation	0		

		Type	*Hex Addr*	*Dec Addr*
P08.76	***PID2 Parameter Switch Deviation 1***	♦R/W	084C	42125
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–P08.77%	10.00		

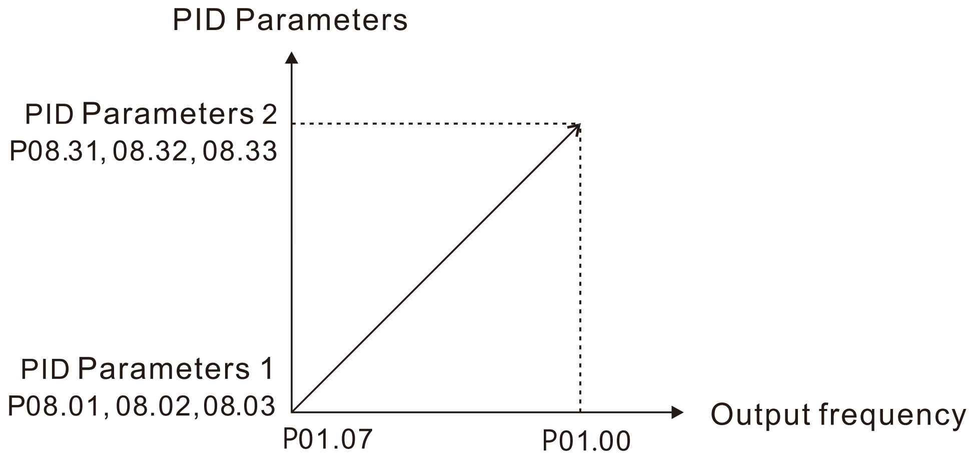
		Type	*Hex Addr*	*Dec Addr*
P08.77	***PID2 Parameter Switch Deviation 2***	♦R/W	084D	42126
	Range/Units (Format: 16-bit unsigned)	*Default*		
	P08.76–100.00%	40.00		

A set of PID parameters cannot meet the requirements of the entire running process in some applications. Use P08.75 to switch to the second set of PID parameters P08.31–P08.33. The setting method for P08.31–P08.33 is the same as that for P08.01–P08.03.

The two sets of PID parameters switch automatically according to the frequency and deviation.

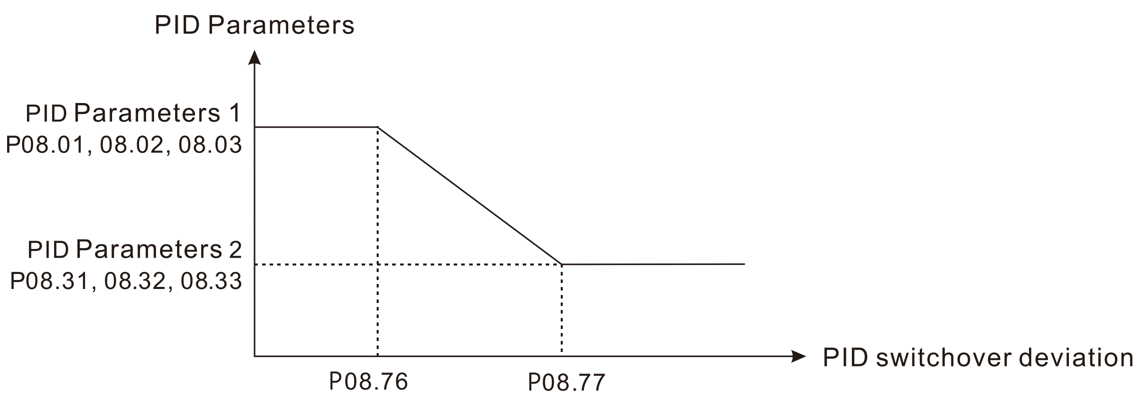
Switch according to the output frequency:

When the output frequency is between P01.07 and P01.00, the PID parameter is the linear interpolation value between the two PID parameter groups.



Switch according to the deviation:

- *When the deviation absolute value between the set point and feedback is smaller than P08.76 (PID2 Parameter Switch Deviation 1), the first group PID parameters are used.*
- *When the deviation absolute value between the set point and feedback is larger than P08.77 (PID2 Parameter Switch Deviation 2), the second group PID parameters are used.*
- *When the deviation absolute value between the set point and feedback is between P08.76 and P08.77, the PID parameter is the linear interpolation value between the two PID parameter groups.*



		Type	Hex Addr	Dec Addr
P08.78	***Allowed Reverse Running Time after Start-up***	♦R/W	084E	42127
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–6553.5 sec.	0.0		

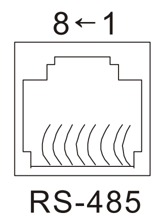
When P08.78 is not set to 0, the allowed reverse running time after start-up is enabled.

When it is set to 1 second, the PID control is not allowed to change the running direction within 0–1 seconds of starting time (P08.21=0), and is allowed to change after 1 second of starting time (P08.21=1).

Group P09.xx Details – Communication Parameters

When connecting the drive to an RS-485 network, the diagram on the right shows the built-in RS-485 communication port pin definitions.

To connect your drive to a PC USB port with GSoft2 software use the USB-485M converter.



Modbus RS-485
Pin 1, 2, 6: Reserved
Pin 3, 7: SGND
Pin 4: SG-
Pin 5: SG+
Pin 8: +10VS

		Type	*Hex Addr*	*Dec Addr*
P09.00	***COM1 Communication Address***	♦R/W	0900	42305
	Range/Units (Format: 16-bit unsigned)	*Default*		
	1–254	1		

P09.00 sets the communication address for the drive if the AC motor drive is controlled through RS-485 serial communication. The communication address for each AC drive must be unique.

		Type	*Hex Addr*	*Dec Addr*
P09.01	***COM1 Transmission Speed***	♦R/W	0901	42306
	Range/Units (Format: 16-bit unsigned)	*Default*		
	4.8–38.4 Kbps	38.4		

P09.01 sets the transmission speed of the RS-485 port of the drive.

Options are 4.8 Kbps, 9.6 Kbps, 19.2 Kbps, or 38.4 Kbps; otherwise, the transmission speed is set to the default 38.4 Kbps.

To connect the optional GS4-KPD remote keypad, value must be set to 19.2.

		Type	*Hex Addr*	*Dec Addr*
P09.02	***COM1 Transmission Fault Treatment***	♦R/W	0902	42307
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning, no fault, and continue operation	3		

P09.02 determines the treatment when an error is detected that the host controller does not continuously transmit data to the AC motor drive during Modbus communication. The detection time is based on the P09.03 setting.

When a transmission error occurs (for example, the error code CE10 displays), the error remains even if the transmission status returns to normal, and is not cleared automatically. In this case, set a reset command (Reset) to clear the error.

		Type	*Hex Addr*	*Dec Addr*
P09.03	***COM1 Time-out Detection***	♦R/W	0903	42308
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–100.0 sec.	0.0		

P09.03 sets the communication time-out value.

		Type	Hex Addr	Dec Addr
P09.04	**COM1 Communication Protocol**	♦R/W	0904	42309
	Range/Units (Format: 16-bit binary)	Default		

1: 7, N, 2 (ASCII)
2: 7, E, 1 (ASCII)
3: 7, O, 1 (ASCII)
4: 7, E, 2 (ASCII)
5: 7, O, 2 (ASCII)
6: 8, N, 1 (ASCII)
7: 8, N, 2 (ASCII)
8: 8, E, 1 (ASCII)
9: 8, O, 1 (ASCII)
10: 8, E, 2 (ASCII)
11: 8, O, 2 (ASCII)
12: 8, N, 1 (RTU)
13: 8, N, 2 (RTU)
14: 8, E, 1 (RTU)
15: 8, O, 1 (RTU)
16: 8, E, 2 (RTU)
17: 8, O, 2 (RTU)

Default: 13

Control by RS-485 Network

When using the RS-485 serial communication interface, you must specify each drive's communication address in P09.00. The RS-485 network master then implements control using the drives' individual addresses.

Modbus ASCII (American Standard Code for Information Interchange): Each byte of data is the combination of two ASCII characters. For example, one byte of data: 64 Hex, shown as '64' in ASCII, consists of '6' (36Hex) and '4' (34Hex).

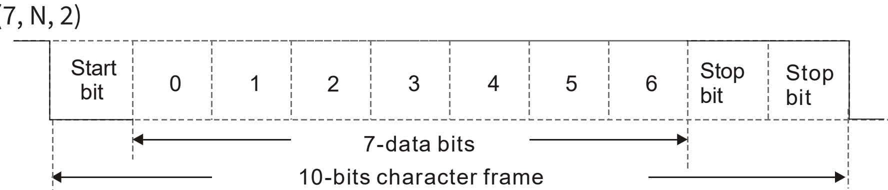
1) Code Description
The communication protocol is in hexadecimal, ASCII: "0" … "9", "A" … "F", every hexadecimal value represents an ASCII code. The following table shows some examples.

Character	**'0'**	**'1'**	**'2'**	**'3'**	**'4'**	**'5'**	**'6'**	**'7'**
ASCII code	30H	31H	32H	33H	34H	35H	36H	37H

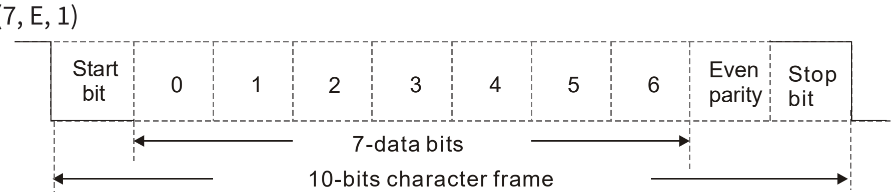
Character	**'8'**	**'9'**	**'A'**	**'B'**	**'C'**	**'D'**	**'E'**	**'F'**
ASCII code	38H	39H	41H	42H	43H	44H	45H	46H

2) Data Format
10-bit character frame (For ASCII):

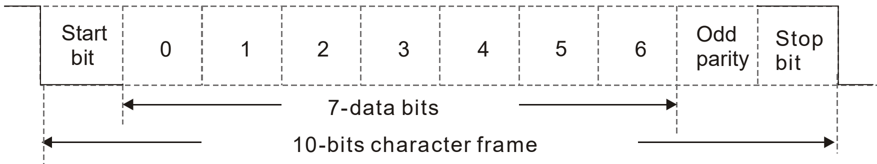
a) (7, N, 2)



b) (7, E, 1)

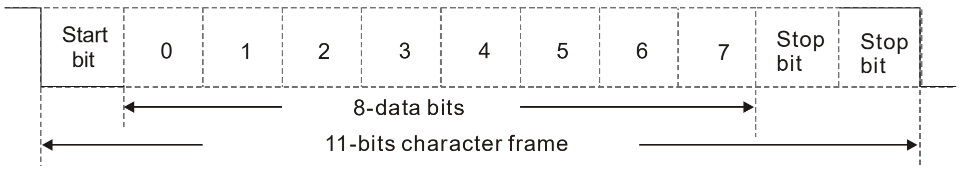


c) (7, O, 1)

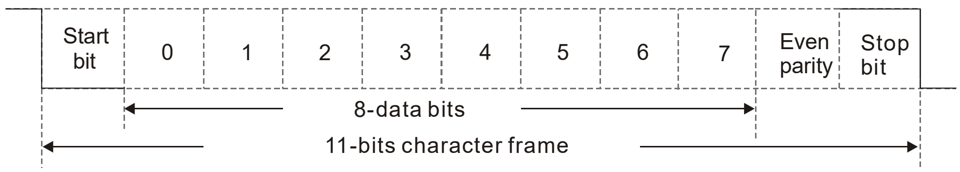


11-bit character frame (For RTU):

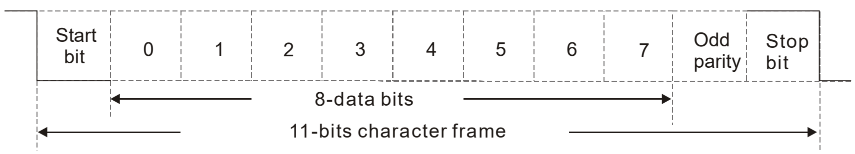
a) (8, N, 2)



b) (8, E, 1)



c) (8, O, 1)



3) Communication Protocol

a) Communication Data Frame

ASCII mode:

STX	Start character = ‘ : ’ (3AH)
Address High	Communication address: one 8-bit address consists of 2 ASCII codes
Address Low	
Function High	Command code: one 8-bit command consists of 2 ASCII codes
Function Low	
DATA (n-1)	Contents of data: n x 8-bit data consists of 2n ASCII codes n ≤ 16, maximum of 32 ASCII codes (20 sets of data)
....	
DATA 0	
LRC Check High	LRC checksum: one 8-bit checksum consists of 2 ASCII codes
LRC Check Low	
END High	End characters: END High = CR (0DH), END Low = LF (0AH)
END Low	

RTU mode:

START	Defined by a silent interval of larger than/equal to 10ms
Address	Communication address: 8-bit binary address
Function	Command code: 8-bit binary command
DATA (n-1)	Contents of data: n × 8-bit data, n ≤ 16
…….	
DATA 0	
CRC Check Low	CRC checksum: one 16-bit CRC checksum consists of 2 8-bit binary characters
CRC Check High	
END	Defined by a silent interval of larger than/equal to 10ms

b) Communication Address (Address)

- *00H: Broadcast to all AC motor drives*
- *01H: AC motor drive at address 01*
- *0FH: AC motor drive at address 15*
- *10H: AC motor drive at address 16*
  :
- *FEH: AC motor drive at address 254*

c) Function (Function code) and DATA (Data characters)

i) 03H: Read data from a register
Example: Reading two continuous data from register address 2102H. AMD address is 01H.
ASCII Mode:

Command Message	
STX	':'
Address	'0'
	'1'
Function	'0'
	'3'
Starting register	'2'
	'1'
	'0'
	'2'
Number of register (count by word)	'0'
	'0'
	'0'
	'2'
LRC Check	'D'
	'7'
END	CR
	LF

Response Message	
STX	':'
Address	'0'
	'1'
Function	'0'
	'3'
Number of register (count by byte)	'0'
	'4'
Content of starting register 2102H	'1'
	'7'
	'7'
	'0'
Content of register 2103H	'0'
	'0'
	'0'
	'0'
LRC Check	'7'
	'1'
END	CR
	LF

RTU Mode:

Command Message	
Address	01H
Function	03H
Starting data register	21H
	02H
Number of register (count by world)	00H
	02H
CRC Check Low	6FH
CRC Check High	F7H

Response Message	
Address	01H
Function	03H
Number of register (count by byte)	04H
Content of register address 2102H	17H
	70H
Content of register address 2103H	00H
	00H
CRC Check Low	FEH
CRC Check High	5CH

ii) 06H: Single write, write single data to a register
Example: Writing data 6000 (1770H) to register 0100H. AMD address is 01H.
ASCII Mode:

Command Message	
STX	':'
Address	'0'
	'1'
Function	'0'
	'6'
Target register	'0'
	'1'
	'0'
	'0'
Register content	'1'
	'7'
	'7'
	'0'
LRC Check	'7'
	'1'
END	CR
	LF

Response Message	
STX	':'
Address	'0'
	'1'
Function	'0'
	'6'
Target register	'0'
	'1'
	'0'
	'0'
Register content	'1'
	'7'
	'7'
	'0'
LRC Check	'7'
	'1'
END	CR
	LF

RTU Mode:

Command Message	
Address	01H
Function	06H
Target register	01H
	00H
Register content	17H
	70H
CRC Check Low CRC Check High	86H
	22H

Response Message	
Address	01H
Function	06H
Target register	01H
	00H
Register content	17H
	70H
CRC Check Low CRC Check High	86H
	22H

iii) 10H: Write multiple registers (can write at most 20 sets of data simultaneously).
Example: Set the multi-step speed of an AC motor drive (address is 01H):
P04.00 = 50.00 (1388H), P04.01 = 40.00 (0FA0H)
ASCII Mode:

Command Message	
STX	':'
ADR 1 ADR 0	'0'
	'1'
CMD 1	'1'
CMD 0	'0'
Target register	'0'
	'5'
	'0'
	'0'
Number of register (count by word)	'0'
	'0'
	'0'
	'2'
Number of register (count by Byte)	'0'
	'4'
The first data content	'1'
	'3'
	'8'
	'8'
The second data content	'0'
	'F'
	'A'
	'0'
LRC Check	'9'
	'A'
END	CR
	LF

Response Message	
STX	':'
ADR 1 ADR 0	'0'
	'1'
CMD 1	'1'
CMD 0	'0'
Target register	'0'
	'5'
	'0'
	'0'
Number of register (count by word)	'0'
	'0'
	'0'
	'2'
LRC Check	'E'
	'8'
END	CR
	LF

RTU Mode:

Command Message	
ADR	01H
CMD	10H
Target register	05H
	00H
Number of register (count by word)	00H
	02H
Quantity of data (byte)	04
The first data content	13H
	88H
The second data content	0FH
	A0H
CRC Check Low	'9'
CRC Check High	'A'

Response Message	
ADR	01H
CMD 1	10H
Target register	05H
	00H
Number of register (count by word)	00H
	02H
CRC Check Low	41H
CRC Check High	04H

d) Checksum

i) ASCII mode (LRC Check):
LRC (Longitudinal Redundancy Check) is calculated by summing up the values of the bytes from ADR1 to the last data character then calculating the hexadecimal representation of the 2's-complement negation of the sum.
For example, as shown in the above Section 3.3.(1),
01H + 03H + 21H + 02H + 00H + 02H = 29H, the 2's-complement negation of 29H is D7H.

ii) RTU mode (CRC Check):
CRC (Cyclical Redundancy Check) is calculated by the following steps:

- ***Step 1:*** *Load a 16-bit register (called CRC register) with FFFFH.*
- ***Step 2:*** *Exclusive OR the first 8-bit byte of the command message with the low order byte of the 16-bit CRC register, and put the result in the CRC register.*
- ***Step 3:*** *Examine the LSB of CRC register.*
- ***Step 4:*** *If the LSB of CRC register is 0, shift the CRC register one bit to the right, fill MSB with zero, then repeat step 3. If the LSB of CRC register is 1, shift the CRC register one bit to the right, fill MSB with zero, Exclusive OR the CRC register with the polynomial value A001H, then repeat step 3.*
- ***Step 5:*** *Repeat step 3 and 4 until you perform eight shifts. This processes a complete 8-bit byte.*
- **Step 6:** Repeat step 2 through 5 for the next 8-bit byte of the command message. Continue doing this until all bytes are processed. The final contents of the CRC register are the CRC value. When transmitting the CRC value in the message, the upper and lower bytes of the CRC value must be swapped, that is, the lower order byte is transmitted first.

The following is an example of CRC generation using C language.

- *The function takes two arguments:*
  Unsigned char data ← a pointer to the message buffer*
  Unsigned char length ← the quantity of bytes in the message buffer
- *The function returns the CRC value as a type of unsigned integer.*

```
Unsigned int crc_chk(unsigned char* data, unsigned char length)
{
  int j;
  unsigned int reg_crc=0Xffff;
  while(length--){
        reg_crc ^= *data++;
        for(j=0;j<8;j++){
              if(reg_crc & 0x01){   /* LSB(b0)=1 */
                    reg_crc=(reg_crc>>1) ^ 0Xa001;
              }else{
                    reg_crc=reg_crc >>1;
              }
        }
  }
  return reg_crc;              // return register CRC
}
```

4) Address list

Content	Function		Hex	Dec	Octal
AC motor drive parameters	GG is the parameter group, nn is the parameter number; for example, the address of P04.10 is 040AH.		GGnn (ex. 040A)	xxxxx (41035)	yyyyy (2012)
Command write only	bit 1–0	00B: No function	2000	48193	20000
		01B: Stop			
		10B: Run			
		11B: JOG + RUN			
	bit 3–2	Reserved			
	bit 5–4	00B: No function			
		01B: FWD			
		10B: REV			
		11B: Change direction			
	bit 7–6	00B: 1st accel. / decel.			
		01B: 2nd accel. / decel.			
		10B: 3rd accel. / decel.			
		11B: 4th accel. / decel.			
	bit 11–8	000B: Master speed			
		0001B: 1st step speed frequency			
		0010B: 2nd step speed frequency			
		0011B: 3rd step speed frequency			
		0100B: 4th step speed frequency			
		0101B: 5th step speed frequency			
		0110B: 6th step speed frequency			
		0111B: 7th step speed frequency			
		1000B: 8th step speed frequency			
		1001B: 9th step speed frequency			
		1010B: 10th step speed frequency			
		1011B: 11th step speed frequency			
		1100B: 12th step speed frequency			
		1101B: 13th step speed frequency			
		1110B: 14th step speed frequency			
		1111B: 15th step speed frequency			
	bit 12	1: Enable bit 06–11 function			
	bit 14–13	00B: No function			
		01B: No function			
		10B: No function			
		11B: No function			
	bit 15	Reserved			
	Frequency command (XXX.XX Hz)		2001	48194	20001
	bit 0	1: E.F. (External Fault) ON	2002	48195	20002
	bit 1	1: Reset command			
	bit 2	1: B.B. ON			
	bit 4–3	Reserved			
	bit 5	1: Enable fire mode			
	bit 15–6	Reserved			
Status monitor read only	High byte: Warning code / Low Byte: Fault code		2100	48449	20400

Content	Function		Hex	Dec	Octal
Status monitor read only (continued)	bit 1–0	AC motor drive operation status 00B: The drive stops 01B: The drive is decelerating 10B: The drive is in standby status 11B: The drive is operating	2101	48450	20401
	bit 2	1: JOG command			
	bit 4–3	Operation direction 00B: FWD running 01B: From REV running to FWD running 10B: From FWD running to REV running 11B: REV running			
	bit 8	1: Master frequency controlled by the communication interface			
	bit 9	1: Master frequency controlled by the analog / external terminal signal			
	bit 10	1: Operation command controlled by the communication interface			
	bit 11	1: Parameter locked			
	bit 12	1: Enable to copy parameters from keypad			
	bit 15–13	Reserved			
	Frequency command (XXX.XX Hz)		2102	48451	20402
	Output frequency (XXX.XX Hz)		2103	48452	20403
	Display the drive's output current (XX.XX A). When the current is higher than 655.35, it automatically shifts one decimal place as (XXX.X A). Refer to the high byte of 211F for information on the decimal places.		2104	48453	20404
	DC bus voltage (XXX.X V)		2105	48454	20405
	Output voltage (XXX.X V)		2106	48455	20406
	Current step for the multi-step speed operation		2107	48456	20407
	Reserved		2108	48457	20410
	Digital Input Counter value		2109	48458	20411
	Output power factor angle (XXX.X)		210A	48459	20412
	Output torque (XXX.X %)		210B	48460	20413
	Actual motor speed (XXXXX rpm)		210C	48461	20414
	Reserved		210D	48462	20415
	Reserved		210E	48463	20416
	Power output (X.XXX kW)		210F	48464	20417
	Multi-function display (P00.04)		2116	48471	20426
	Maximum Operation Frequency (P01.00) or Maximum User-defined Value (P00.26) When P00.26 is 0, this value is equal to P01.00 setting When P00.26 is not 0, and the command source is keypad, this value = P00.24 * P00.26 / P01.00. When P00.26 is not 0, and the command source is 485, this value = P09.10 * P00.26 / P01.00.		211B	48476	20433
	High byte: the decimal place of current value (display)		211F	48480	20437
	Display the drive's output current (XX.XX A). When the current is higher than 655.35, it automatically shifts one decimal place as (XXX.X A). Refer to the high byte of 211F for information on the decimal places.		2200	48705	21000
	Counter value		2201	48706	21001
	Actual output frequency (XXXXX Hz)		2202	48707	21002
	DC bus voltage (XXX.X V)		2203	48708	21003

Content	Function	Hex	Dec	Octal
Status monitor read only (continued)	Output voltage (XXX.X V)	2204	48709	21004
	Power factor angle (XXX.X)	2205	48710	21005
	Display the output power of U, V, W (XXXX.X kW)	2206	48711	21006
	Display the motor speed estimated by the drive or encoder feedback (XXXXX rpm)	2207	48712	21007
	Display the positive / negative output torque estimated by the drive (+0.0: positive torque; -0.0: negative torque) (XXX.X%)	2208	48713	21010
	Reserved	2209	48714	21011
	Display the PID feedback value after enabling PID function (XXX.XX%)	220A	48715	21012
	Display the AI-V analog input terminal signal, 0–10 V corresponds to 0.00–100.00% (see Explanation 1 in Pr.00-04)	220B	48716	21013
	Display the AI-C analog input terminal signal, 4–20 mA corresponds to 0.00–100.00% (2.) (see Explanation 2 in P00.04)	220C	48717	21014
	Reserved	220D	48718	21015
	IGBT temperature of the power module (XXX.X °C)	220E	48719	21016
	Reserved	220F	48720	21017
	The digital input status (ON / OFF), refer to P02.12 (see Explanation 2 in P00.04)	2210	48721	21020
	The digital output status (ON / OFF), refer to P02.18 (see Explanation 3 in P00.04)	2211	48722	21021
	Current step for the multi-step speed operation	2212	48723	21022
	The corresponding CPU digital input pin status (d.) (see Explanation 2 in P00.04)	2213	48724	21023
	The corresponding CPU digital output pin status (O.) (see Explanation 3 in P00.04)	2214	48725	21024
	Reserved	2215	48726	21025
	Pulse input frequency (XXX.XX Hz)	2216	48727	21026
	Reserved	2217	48728	21027
	Reserved	2218	48729	21030
	Counter value of overload (XXX.XX %)	2219	48730	21031
	GFF (XXX.XX %)	221A	48731	21032
	DC bus voltage ripples (XXX.X V)	221B	48732	21033
	Reserved	221C	48733	21034
	Number of poles of a permanent magnet motor	221D	48734	21035
	User page displays the value in physical measure	221E	48735	21036
	Output value of P00.05 (XXX.XX Hz)	221F	48736	21037
	Reserved	2220	48737	21040
	Reserved	2221	48738	21041
	Reserved	2222	48739	21042
	Control mode of the drive 0: speed mode	2223	48740	21043
	Carrier frequency of the drive (XX kHZ)	2224	48741	21044
	Reserved	2225	48742	21045

Content	Function		Hex	Dec	Octal
Status monitor read only (continued)	Drive status		2226	48743	21046
	bit 1–0	00b: No direction			
		01b: Forward			
		10b: Reverse			
	bit 3–2	01b: Drive ready			
		10b: Error			
	bit 4	0b: Motor drive does not output			
		1b: Motor drive outputs			
	bit 5	0b: No warning			
		1b: Warning			
	Drive's estimated output torque (positive or negative direction) (XXXX N•m)		2227	48744	21047
	Reserved		2228	48745	21050
	KWH display (XXXX.X)		2229	48746	21051
	Reserved		222A	48747	21052
	Reserved		222B	48748	21053
	Reserved		222C	48749	21054
	Reserved		222D	48750	21055
	PID target value (XXX.XX %)		222E	48751	21056
	PID offset (XXX.XX %)		222F	48752	21057
	PID output frequency (XXX.XX Hz)		2230	48753	21060
	Reserved		2231	48754	21061
	Display the auxiliary frequency		2232	48755	21062
	Display the master frequency		2233	48756	21063
	Display the frequency after adding and subtracting of the master and auxiliary frequencies.		2234	48757	21064

5) Exception response:
When the drive is using the communication connection, if an error occurs, the drive responds to the error code and sets the highest bit (bit 7) of the command code to 1 (function code AND 80H) then responds to the control system to signal that an error occurred.
If the keypad displays "CE-XX" as a warning message, "XX" is the error code at that time. Refer to the table of error codes for communication error for reference.
Example:

ASCII Mode	
STX	':'
Address	'0'
	'1'
Function	'8'
	'6'
Exception code	'0'
	'2'
LRC Check	'7'
	'7'
END	CR
	LF

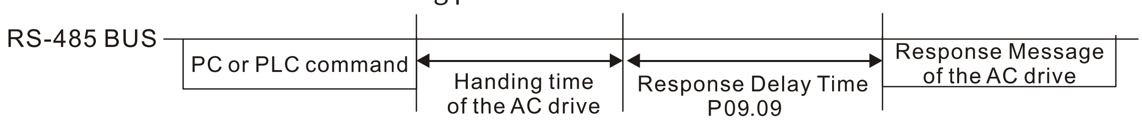
RTU Mode	
Address	01H
Function	86H
Exception code	02H
CRC Check Low	C3H
CRC Check High	A1H

The following table describes the exception code.

Exception Code	Description
1	Function code is not supported or unrecognized.
2	Address is not supported or unrecognized.
3	Data is not correct or unrecognized.
4	Failure to execute this function code

		Type	Hex Addr	Dec Addr
P09.09	**Communication Response Delay Time**	♦R/W	0909	42314
	Range/Units (Format: 16-bit unsigned)	Default		
	0.0–200.0 ms	2.0		

If the host controller does not finish the transmitting/receiving process, you can use this parameter to set the response delay time after the AC motor drive receives communication command as shown in the following picture.



		Type	Hex Addr	Dec Addr
P09.10	**Communication Main Frequency**	R/W	090A	42315
	Range/Units (Format: 16-bit unsigned)	Default		
	0.00–599.0 Hz	60.00		

When you set P00.20 to 1 (RS-485 communication input), the AC motor drive saves the last Frequency command into P09.10 when there is abnormal power off or momentary power loss. When power is restored, the AC motor drive operates with the frequency in P09.10 if there is no new Frequency command input. When a Frequency command of 485 changes (the Frequency command source must be set as Modbus), this parameter also changes.

		Type	Hex Addr	Dec Addr
P09.11	**Block Transfer 1**	♦R/W	090B	42316
P09.12	**Block Transfer 2**	♦R/W	090C	42317
P09.13	**Block Transfer 3**	♦R/W	090D	42318
P09.14	**Block Transfer 4**	♦R/W	090E	42319
P09.15	**Block Transfer 5**	♦R/W	090F	42320
P09.16	**Block Transfer 6**	♦R/W	0910	42321
P09.17	**Block Transfer 7**	♦R/W	0911	42322
P09.18	**Block Transfer 8**	♦R/W	0912	42323
P09.19	**Block Transfer 9**	♦R/W	0913	42324
P09.20	**Block Transfer 10**	♦R/W	0914	42325
P09.21	**Block Transfer 11**	♦R/W	0915	42326
P09.22	**Block Transfer 12**	♦R/W	0916	42327
P09.23	**Block Transfer 13**	♦R/W	0917	42328
P09.24	**Block Transfer 14**	♦R/W	0918	42329
P09.25	**Block Transfer 15**	♦R/W	0919	42330
P09.26	**Block Transfer 16**	♦R/W	091A	42331

Range/Units (Format: 16-bit unsigned) — *Default*

0–65535 — 0

This is a group of block transfer parameters that is available for communications use in the drive (P09.11–P09.26). Using communication code 03H, you can store the parameters (P09.11–P09.26) that you want to read.

		Type	Hex Addr	Dec Addr
P09.30	**Communication Decoding Method**	R/W	091E	42335

Range/Units (Format: 16-bit binary) — *Default*

0: Decoding method 1 — 0
1: Decoding method 2

Source of Operation Control	Decoding Method 1	Decoding Method 2
Digital Keypad	Digital keypad controls the drive action regardless of decoding method 1 or 2.	
External Terminal	External terminal controls the drive action regardless of decoding method 1 or 2.	
RS-485	Refer to address: 2000h–20FFh	Refer to address: 2000h–20FFh

Use Decoding Method 1. Decoding Method 2 is not supported at this time.

		Type	Hex Addr	Dec Addr
P09.31	**Internal Communication Protocol**	R/W	091F	42336

Range/Units (Format: 16-bit unsigned) — *Default*

0: Modbus 485 — 0
-21: Pump Master
-22: Pump Slave 1
-23: Pump Slave 2
-24: Pump Slave 3

This parameter is used to set the drive pump address if using the multi-pump control function in Parameter Group 12. Parameter P12.14 must be set to zero for use of this parameter.

Group P10.xx Details – Speed Feedback Control Parameters

		Type	Hex Addr	Dec Addr
P10.16	***Pulse Input Type Setting (PG2)***	♦R/W	0A10	42577
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disabled 5: Single-phase input (DI5) 6: PWM signal input	0		

- *When P00.20 = 4, the command source is DI5. Then, you can select external command as PWM mode through P10.16.*
- *When you set P10.16 = 0, the function for this parameter is disabled.*
- *When you set P10.16 = 5, the pulse input type is single-phase pulse mode with a steady maximum input pulse frequency of 10 kHz and a corresponding relationship between 0–10 kHz pulse signal and 0–Fmax (P01.00) frequency command. For example, if 10 ÷ 2 = 5 kHz pulse signal corresponds to Fmax ÷ 2 frequency command, and when the input pulse exceeds 10 kHz, the frequency command remains at Fmax (P01.00).*
- *When you set P10.16 = 6, pulse input type is PWM mode. You can set how long the PWM outputs a command after how many times of averaging and set the period of external PWM both through P12.51. The average value for frequency command and output speed depends on the settings for these two parameters. Refer to P12.51 for detailed descriptions.*

		Type	Hex Addr	Dec Addr
P10.29	***Upper Limit of Frequency Deviation***	♦R/W	0A1D	42590
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–200.00 Hz	20.00		

P10.29 limits the maximum frequency deviation.

Limits the maximum frequency deviation.

- *If you set this parameter too high, an abnormal feedback malfunction occurs.*

		Type	Hex Addr	Dec Addr
P10.31	***I/F Mode, Current Command***	♦R/W	0A1F	42592
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–150% rated current of the motor	40		

P10.31 is only applicable to PM motors with P00.11= 2: PMSVC. See Function diagram under P00.11 on page 4–52.

P10.31 sets the current command for the drive in the low speed area (low speed area: Frequency command < P10.39). When the motor stalls on heavy duty start-up or forward/reverse with load, increase the parameter value. If the inrush current is too high and causes oc stall, then decrease the parameter value.

		Type	Hex Addr	Dec Addr
P10.32	***PM Sensorless Speed Estimator Bandwidth***	♦R/W	0A20	42593
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–600.0 Hz	5.00		

P10.32 is only applicable to PM motors with P00.11= 2: PMSVC. See Function diagram under P00.11 on page 4–52.

P10.32 sets the speed estimator bandwidth. Adjust the parameter to influence the stability and the accuracy of the motor speed.

If there is low frequency vibration (the waveform is similar to a sine wave) during the process, then increase the bandwidth. If there is high frequency vibration (the waveform shows extreme vibration and is like a spur), then decrease the bandwidth.

		Type	Hex Addr	Dec Addr
P10.34	***PM Sensorless Speed Estimator Low-pass Filter Gain***	♦R/W	0A22	42595
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–655.35	1.00		

P10.34 is only applicable to PM motors with P00.11= 2: PMSVC. See Function diagram under P00.11 on page 4–52.

P10.34 influences the response speed of the speed estimator.

If there is low frequency vibration (the waveform is similar to a sine wave) during the process, then increase the gain. If there is high frequency vibration (the waveform shows extreme vibration and is like a spur), then decrease the gain.

		Type	Hex Addr	Dec Addr
P10.42	***Initial Angle Detection Pulse Value***	♦R/W	0A2A	42603
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–3.0	1.0		

P10.42 is only applicable to SPM motors with P00.11=2:PMSVC. See Function diagram under P00.11 on page 4–52.

P10.42 is only active when P10.53=3:Pulse Injection.

The angle detection is fixed to 3: Use the pulse injection method to start. The parameter influences the value of the pulse during the angle detection. The larger the pulse, the higher the accuracy of rotor's position. A larger pulse might cause oc.

Increase the parameter when the running direction and the command are opposite during start-up. If oc occurs at start-up, then decrease the parameter.

Refer to Adjustment & Application for detailed motor adjustment procedure.

		Type	Hex Addr	Dec Addr
P10.49	***Zero Voltage Time during Start-up***	♦R/W	0A31	42610
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.000–60.000 sec.	0.000		

P10.49 is valid only when the setting of P07.12 (Speed Tracking during Start-up) = 0.

When the motor is in static state at start-up, this increases the accuracy when estimating angles. In order to put the motor in static state, set the drive three-phase output to the motor to 0V. The P10.49 setting time is the length of time for three-phase output at 0 V.

It is possible that even when you apply this parameter, the motor cannot go in to the static state because of inertia or some external force. If the motor does not go into a complete static state in 0.2 seconds, increase this setting value appropriately.

If P10.49 is set too high, the start-up time is longer. If it is too low, then the braking performance is weak.

		Type	Hex Addr	Dec Addr
P10.51	***Injection Frequency***	♦R/W	0A33	42612
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–1200 Hz	500		

P10.51 is a high frequency injection command in PM SVC control mode, and usually you do not need to adjust it. But if a motor's rated frequency (for example, 400Hz) is too close to the frequency setting for this parameter (that is, the default of 500Hz), it affects the accuracy of the angle detection. Refer to the setting for P01.01 before you adjust this parameter.

- *If the setting value for P00.17 is lower than P10.51*10, then increase the frequency of the carrier frequency.*
- *P10.51 is valid only when P10.53 = 2.*

		Type	Hex Addr	Dec Addr
P10.52	***Injection Magnitude***	♦R/W	0A34	42613
	Range/Units (Format: 16-bit unsigned)	*Default*		
	120V / 230V series: 100.0 V 460V series: 200.0 V Note: The setting range varies depending on the voltage.	15.0 / 30.0		

P10.52 is the magnitude command for the high frequency injection signal in PM SVC control mode.

Increasing the parameter can increase the accuracy of the angle estimation, but the electromagnetic noise might be louder if the setting value is too high.

- *The system uses this parameter when the motor's parameter is "Auto". This parameter influences the angle estimation accuracy.*
- *When the ratio of the salient pole (Lq / Ld) is lower, increase P10.52 to make the angle detection accurate.*
- *P10.52 is valid only when P10.53 = 2.*

		Type	Hex Addr	Dec Addr
P10.53	***Angle Detection Method***	♦R/W	0A35	42614
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disabled 1: Force attracting the rotor to zero degrees 2: High frequency injection 3: Pulse injection	0		

Set P10.53 = 2 for IPM; set to 3 for SPM. If these settings cause problems, then set the parameter to 1.

Group P11.xx Details – Advanced Parameters

In this parameter group the following abbreviations are used:

- *ASR - Adjustable Speed Regulation. ASR parameters are for tuning the zero, low and high speed ranges of the drive when in IMFOC sensorless vector speed control mode (P00.11=5) or IMVFPG (P00.11=1) speed control mode.*

Parameters P11.00 – P11.16 are used to configure the Adjust Speed Regulator.

Parameters P11.17 – P11.38 are used to configure Torque control parameters.

		Type	*Hex Addr*	*Dec Addr*
P11.00	***Adjust Speed Regulator (ASR) System Control***	R/W	0B00	42817
	Range/Units (Format: 16-bit binary)	*Default*		
	bit 3: Dead time compensation closed bit 7: Save or do not save the frequency	0		

When P11.00 bit 3= 1, Dead time compensation is enabled. Dead time is to prevent short circuit of upper and lower arm of PWM during switching. This calculates a smoother output curve.

When P11.00 bit 7 = 0: Save the frequency before power is OFF. When power is ON again, the saved frequency is displayed.

When P11.00 bit 7 = 1: The frequency is not saved when power is cycled OFF. When power is cycled ON again, 0.00 Hz is the displayed frequency.

See Function diagram under P00.11 on page 4–52.

		Type	*Hex Addr*	*Dec Addr*
P11.41	***PWM Mode Selection***	R/W	0B29	42858
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Two-phase modulation mode 2: Space vector modulation mode	2		

Two-phase modulation mode: effectively reduces the drive power component losses and provides better performance in long wiring applications.

Space vector modulation mode: effectively reduces the power loss and electromagnetic noise of the motor.

		Type	*Hex Addr*	*Dec Addr*
P11.42	***System Control Flag***	R/W	0B2A	42859
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0000–FFFFh	0000		

bit No.	Function	Description
0	Reserved	
1	FWD / REV action control	0: FWD / REV cannot be controlled by P02.12 bit 0 & 1. 1: FWD / REV can be controlled by P02.12 bit 0 & 1.

Group P12.xx Details – Function Parameters

In this parameter group, ASR stands for Adjust Speed Regulator.

Parameter group 12 is used to set up special functions inside the drive.

- *P12.00- P12.15- Multi- Pump Control*
- *P12.20 – P12.35 – Simple Positioning setup*
- *P12.40 – P12.49 – Automation operation program*

		Type	Hex Addr	Dec Addr
P12.00	***Set Point Deviation Level***	♦R/W	0C00	43073
	Range/Units (Format: 16-bit binary)	*Default*		
	0–100%	0		

		Type	Hex Addr	Dec Addr
P12.01	***Detection Time of Set Point Deviation Level***	♦R/W	0C01	43074
	Range/Units (Format: 16-bit binary)	*Default*		
	1–9999 seconds	10		

When the deviation is less than P12.00 (in the range of PID set point to P12.00 x PID set point) for a time exceeding the setting of P12.01, the AC motor drive decelerates to stop to be constant pressure status (this deceleration time is the setting for P01.15). The system is ready when the deviation is within the range of PID set point to P12.00 x PID set point during deceleration.

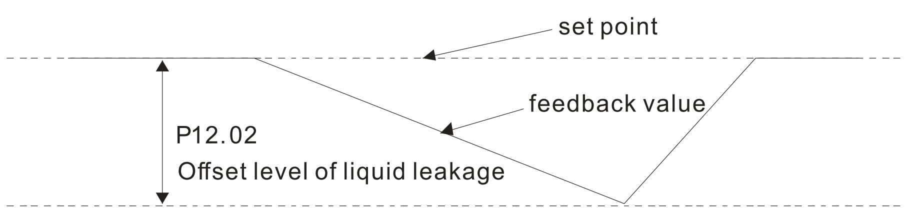
Example:

If the set point of constant pressure control of a pump is 4 kg, P12.00 is set to 5%, and P12.01 is set to 15 seconds, then the deviation is 0.2 kg (4 kg × 5%=0.2 kg). It means when the feedback value is higher than 3.8 kg for a time exceeding 15 seconds, the AC motor drive decelerates to stop (this deceleration time acts according to P01.12). When the feedback value is less than 3.8 kg, the AC motor drive starts to run.

		Type	Hex Addr	Dec Addr
P12.02	***Offset Level of Liquid Leakage***	♦R/W	0C02	43075
	Range/Units (Format: 16-bit binary)	*Default*		
	0–50%	0		

P12.02 is used to prevent the drive from frequent run/stop operation due to liquid leaks.

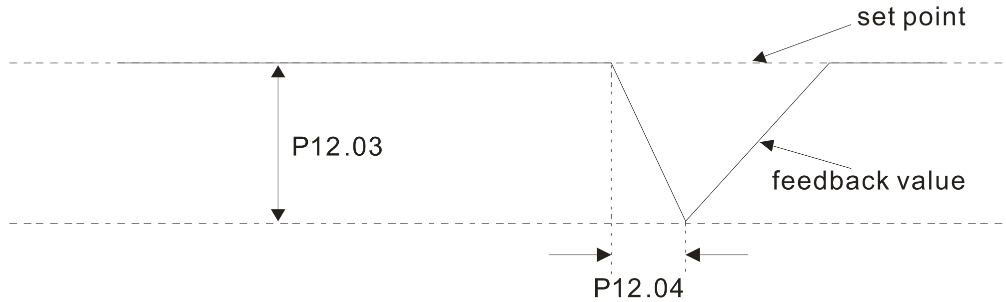
In the constant pressure status, when the liquid leakage is higher than P12.02 x PID set point, the AC motor drive starts to run.



		Type	Hex Addr	Dec Addr
P12.03	***Liquid Leakage Change Detection***	♦R/W	0C03	43076
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable 0–100%	0		

		Type	Hex Addr	Dec Addr
P12.04	***Time Setting for Liquid Leakage Change***	♦R/W	0C04	43077
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable 0.1–10.0 seconds	0.5		

When the change of feedback value is less than the settings for P12.03 and P12.04, the liquid leakage occurs. When the system is in constant pressure status, the AC motor drive starts to run if the feedback value is higher than these two settings.



Example:

If the set point of constant pressure control of a pump is 4 kg, P12.00 is set to 5%, P12.01 is set to 15 seconds, P12.02 is set to 25%, P12.03 is set to 3% and P12.04 is set to 0.5 seconds, then the offset is 0.2 kg (4 kgX5%=0.2 kg). It means when the feedback value is higher than 3.8 kg for a time exceeding 15 seconds, the AC motor drive decelerates to stop (this deceleration time acts according to P01.15). When the feedback value is less than 3.8 kg, the AC motor drive starts to run.

- *Status 1:*
  If the AC motor drive is in the constant pressure status and the feedback change value is less than 0.12 kg within 0.5 seconds. The AC motor drive does not run until the feedback value decreases by this proportion to the value less than 3 kg.
- *Status 2:*
  When the AC motor drive is in constant pressure, it does not run until the feedback change value is less than 3.88 kg for a time exceeding 0.5 seconds.

		Type	Hex Addr	Dec Addr
P12.05	***Multi-Pump Control Mode***	R/W	0C05	43078
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable 1: Fixed time circulation (alternative operation) 2: Fixed quantity control (multi-pump)	0		

When using multi-pump control mode, the P12.05 setting for each pump must be the same.

		Type	Hex Addr	Dec Addr
P12.07	***Multi-pump's Fixed Time Circulation Period***	♦R/W	0C07	43080
	Range/Units (Format: 16-bit binary)	*Default*		
	1–65535 minutes	60		

This parameter only applies for the master pump.

- *Fixed time circulation mode (alternative operation). For example, when pump 01's operating time is longer than the setting at P12.07, pump #1 is stopped then pump #2 is activated, etc.*
- *Fixed quantity control (multi-pump runs at constant pressure). For example, when master pump's operating time is longer than the setting at P12.07, master pump switches to the slave pump.*

		Type	Hex Addr	Dec Addr
P12.08	***Frequency to Start Switching Pumps***	♦R/W	0C08	43081
	Range/Units (Format: 16-bit binary)	*Default*		
	0.00 Hz–FMAX (P01.00)	60.00		

		Type	Hex Addr	Dec Addr
P12.09	***Time Detected when Pump Reaches Starting Frequency***	♦R/W	0C09	43082
	Range/Units (Format: 16-bit binary)	*Default*		
	0.0–3600.0 seconds	1.0		

		Type	Hex Addr	Dec Addr
P12.10	***Frequency to Stop Switching Pumps***	♦R/W	0C0A	43083
	Range/Units (Format: 16-bit binary)	*Default*		
	0.00 Hz–FMAX (P01.00)	48.00		

		Type	Hex Addr	Dec Addr
P12.11	***Time Detected when Pump Reaches the Stopping Frequency***	♦R/W	0C0B	43084
	Range/Units (Format: 16-bit binary)	*Default*		
	0.0–3600.0 seconds	1.0		

P12.11 only applies for the master pump.

This parameter only works under fixed quantity control (multi-pump operating at constant pressure)

- *When the master pump's operating frequency ≥ P12.08 and the time elapsed exceeds P12.09, a slave pump #1 will be activated. If the quantity of water is still insufficient, slave pump #2 and #3 will be activated under the same conditions.*
- *If the master pump's operating frequency ≤ P12.10 and the time elapsed exceeds P12.11, slave pump #1 stops. If the master pump still satisfies those conditions, then the slave pump #2 and #3 stop consecutively, the master pump remains in operation.*
- *The run or stop of the master pump depends on the automation stop function.*

		Type	Hex Addr	Dec Addr
P12.12	***Pump's Frequency at Time-out (Disconnection)***	♦R/W	0C0C	43085
	Range/Units (Format: 16-bit binary)	*Default*		
	0.00–FMAX (P01.00)	0.00		

This parameter only applies for slave pumps.

- *Refer to P09.02 COM1 transmission fault treatment and P09.03 COM1 time-out detection for the conditions to disconnect communication and treatment.*
- *If there is a time-out occurred under fixed quantity control (multi-pump operating at constant pressure) and a slave pump's time-out frequency = P12.12, that slave pump is in stand-alone mode after stop command is given.*
- *The master pump has the function to redetect if a slave pump is time-out.*

		Type	Hex Addr	Dec Addr
P12.13	***Pump's Error Treament***	R/W	0C0D	43086
	Range/Units (Format: 16-bit binary)	*Default*		

bit 0: Whether to switch to an alternative pump when operation pump error occurs.
- 0: Stop all pump actions.
- 1: Switch to an alternative pump.

bit 1: Standby or stop after resetting from error.
- 0: Standby after reset.
- 1: Stop after reset.

bit 2: To run a pump or not when an error is occurred.
- 0: Do not start.
- 1: Select an alternative pump.

Default: 1

This parameter only applies for the master pump.

- *bit 0: If any error occurred during an operation, should the master pump switch to an alternative pump?*
  0: Stop all the pump actions
  1: Switch to an alternative pump
  For example, when bit 0 = 0, if any error occurred during an operation, all the pumps stop. When bit 0 = 1, if there is any error during an operation, the erroneous pump switches to an alternative pump.
- *bit 1: Stop or put the erroneous pump in standby mode after reset it?*
  0: Reset the erroneous pump and put it in standby mode (this pump can receive RUN command).
  1: Reset the erroneous pump and stop it (this pump cannot receive RUN command).
  For example, when bit1 = 0, once the erroneous pump is reset, this pump can be in control again to keep running. When bit1 = 1, once the erroneous pump is reset, this pump cannot be in control to run again. Only after the master pump gives a RUN command, then that slave pump is able to run again.
- *bit 2: Can the master pump accept a RUN command when there is an erroneous pump?*
  0: When there is an erroneous pump, the master pump rejects the RUN command.
  1: When there is an erroneous pump, the master pump chooses an alternative pump to run.
  For example, when bit2 = 0, the master pump rejects the RUN command, while drive #2 has an error. When bit2 = 1, the master pump accepts the RUN command and choose an alternative pump to run, while drive #2 has an error.

This parameter only works under auto mode.

		Type	Hex Addr	Dec Addr
P12.14	***Selection of Pump Start-up Sequence***	R/W	0C0E	43087
	Range/Units (Format: 16-bit binary)	*Default*		
	0: By pump's ID#	1		
	1: By the running time			

- *0: By pump ID#, (1→2→3→4→1)*
- *1: By the shortest running time*

		Type	Hex Addr	Dec Addr
P12.15	***Running Time of Multi-pump under Alternative Operation***	♦R/W	0C0F	43088
	Range/Units (Format: 16-bit binary)	*Default*		
	0.0–360.0 seconds	60.0		

This parameter only applies for the master pump.

The assigned value (setting value) of time to switch between master pump and slave pump.

		Type	Hex Addr	Dec Addr
P12.20	***Simple Positioning Stop Frequency 0***	♦R/W	0C14	43093
	Range/Units (Format: 16-bit binary)	*Default*		
	0.00–599.0 Hz	0.00		

		Type	Hex Addr	Dec Addr
P12.21	***Simple Positioning Stop Frequency 1***	♦R/W	0C15	43094
	Range/Units (Format: 16-bit binary)	*Default*		
	0.00–599.0 Hz	5.00		

		Type	Hex Addr	Dec Addr
P12.22	***Simple Positioning Stop Frequency 2***	♦R/W	0C16	43095
	Range/Units (Format: 16-bit binary)	*Default*		
	0.00–599.0 Hz	10.00		

		Type	Hex Addr	Dec Addr
P12.23	***Simple Positioning Stop Frequency 3***	♦R/W	0C17	43096
	Range/Units (Format: 16-bit binary)	*Default*		
	0.00–599.0 Hz	20.00		

		Type	Hex Addr	Dec Addr
P12.24	***Simple Positioning Stop Frequency 4***	♦R/W	0C18	43097
	Range/Units (Format: 16-bit binary)	*Default*		
	0.00–599.0 Hz	30.00		

		Type	Hex Addr	Dec Addr
P12.25	***Simple Positioning Stop Frequency 5***	♦R/W	0C19	43098
	Range/Units (Format: 16-bit binary)	*Default*		
	0.00–599.0 Hz	40.00		

		Type	Hex Addr	Dec Addr
P12.26	***Simple Positioning Stop Frequency 6***	♦R/W	0C1A	43099
	Range/Units (Format: 16-bit binary)	*Default*		
	0.00–599.0 Hz	50.00		

		Type	Hex Addr	Dec Addr
P12.27	***Simple Positioning Stop Frequency 7***	♦R/W	0C1B	43100
	Range/Units (Format: 16-bit binary)	*Default*		
	0.00–599.0 Hz	60.00		

The settings for P12.20–P12.27 must meet the following condition:
P12.20 ≤ P12.21 ≤ P12.22 ≤ P12.23 ≤ P12.24 ≤ P12.25 ≤ P12.26 ≤ P12.27.

If any two of the parameters (between P012.20–P12.27) have the same stop frequency, their Delay Time of Simple Positioning Stop must be the same as well.

		Type	Hex Addr	Dec Addr
P12.28	***Delay Time of Simple Positioning Stop 0***	♦R/W	0C1C	43101
P12.29	***Delay Time of Simple Positioning Stop 1***	♦R/W	0C1D	43102
P12.30	***Delay Time of Simple Positioning Stop 2***	♦R/W	0C1E	43103
P12.31	***Delay Time of Simple Positioning Stop 3***	♦R/W	0C1F	43104
P12.32	***Delay Time of Simple Positioning Stop 4***	♦R/W	0C20	43105
P12.33	***Delay Time of Simple Positioning Stop 5***	♦R/W	0C21	43106
P12.34	***Delay Time of Simple Positioning Stop 6***	♦R/W	0C22	43107
P12.35	***Delay Time of Simple Positioning Stop 7***	♦R/W	0C23	43108

Range/Units (Format: 16-bit binary) — *Default*

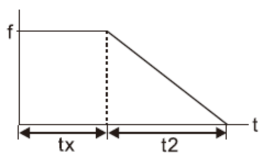
0.00–600.0 seconds — 0.00

Valid only when P00.22 is set to 2: motor stops by simple positioning. This commands the drive to stop in a set distance instead of a set time.

The settings for P12.20–P12.27 must correspond to the settings for P12.28–P12.35. Corresponding parameters :

(P12.20, P12.28)	(P12.21, P12.29)	(P12.22, P12.30)	(P12.23, P12.31)
(P12.24, P12.32)	(P12.25, P12.33)	(P12.26, P12.34)	(P12.27, P12.35)

The function of P12.28–P12.35 is simple positioning. Speed starts to decelerate after the time set at P12.28–P12.35 elapse. The accuracy of positioning is self-assessed by user.



$$S = n \times \left(\frac{t_x + (t_x + t_2)}{2} \right) \qquad n = f \times \frac{120}{p}$$

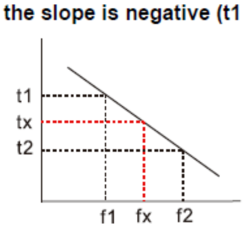
$$S = n \times \left(\frac{t_x + (t_x + t_2)}{2} \right) \qquad n = f \times \frac{120}{p}$$

s: distance travelled (revolution)
n: rotation speed (revolution/second)
t_x: delay time (second)
t_2: deceleration time (second)

n: rotation speed (rmp) (revolution/ minute)
p: number of poles of motors
f: rotation frequency (Hz)

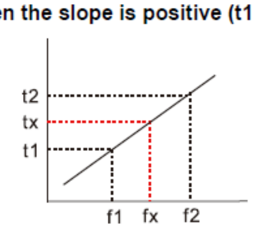
The value of t_x in the equation above is as shown below:

1.1 When the slope is negative (t1 > t2)



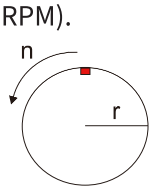
$$t_x = t_1 + \left(\frac{f_x - f_1}{f_2 - f_1}\right) \times (t_2 - t_1) = t_1 + \left(\frac{f_x - f_1}{10}\right) \times (t_2 - t_1)$$

1.2 When the slope is positive (t1 < t2)



$$t_x = t_2 - \left(\frac{f_2 - f_x}{f_2 - f_1}\right) \times (t_2 - t_1) = t_2 - \left(\frac{f_2 - f_x}{10}\right) \times (t_2 - t_1)$$

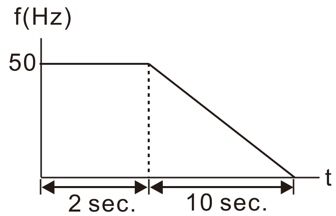
As shown in the image below, a four-pole motor turntable's diameter = r and its rotation speed = n (RPM).



Example 01:

When the motor turntable is rotating at 50 Hz, P00.22 =2 (motor stops by simple positioning), P12.26=50 Hz (Simple Positioning Stop Frequency 6), and its corresponding P12.34 =2 seconds (Delay Time of Simple Positioning Stop 6) , the deceleration time is 10 seconds for decreasing from 50 Hz to 0 Hz.

When STOP command is given, Simple Positioning Stop is activated, its rotation speed is n = 120 x 50 / 4 (revolution / minute) = 25 (revolution / second). Number of revolutions of motor turntable = (25 x (2 + 12)) / 2 = 175 (revolutions).

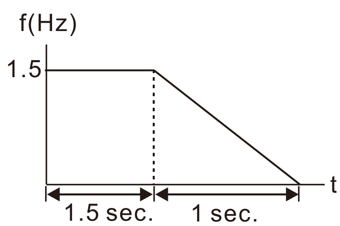


Therefore, the distance travelled by the motor after the STOP command is given = number of revolutions x circumference = 175x 2 π r. It means the turntable returns to the top after 175 revolutions.

Example 02:

If the turntable rotates at 1.5 Hz, P12.22 = 10 Hz (Simple Positioning Stop Frequency 2), P12.21 = 0 Hz, and P12.30 =10 seconds (Delay Time of Simple Positioning Stop 2), then the deceleration time is 40 seconds for decreasing from 60 Hz to 0 Hz. The delay time to stop of 1.5 Hz is 1.5 seconds, the deceleration time is 1 second for decreasing from 1.5 Hz to 0 Hz.

When STOP command is given, Simple Positioning Stop is activated, its rotation speed is n = 120 x 1.5 / 4 (revolution / minute) = 1.5 / 2 (revolution / second). Number of revolutions of motor turntable = (1.5/2 x (1.5 + 2.5)) / 2 = 1.5 (revolutions)



Therefore, the distance travelled by the motor after the STOP command is given = number of revolutions x circumference = 1.5x 2 π r. It means the turntable stopped after 1.5 revolutions.

		Type	*Hex Addr*	*Dec Addr*
P12.40	***Automation Operation Mode***	R/W	0C28	43113
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable operation 2: Continuously execute program cycles 3: Execute one program cycle step by step 4: Continuously execute one program cycle step by step 5: Disable automatic operation, but the direction setting at multi-step speed	0		

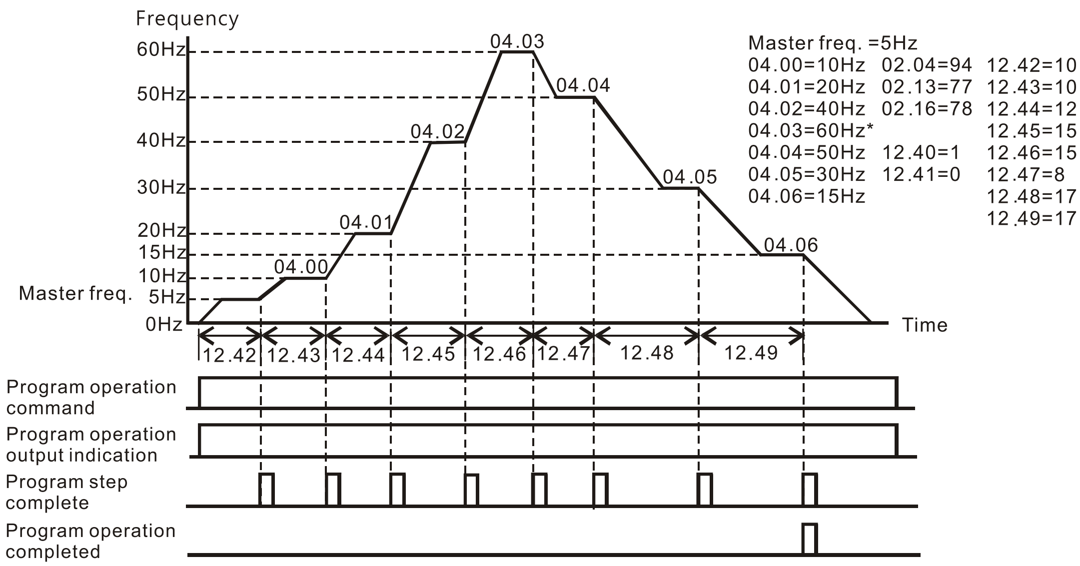
P12.40 selects the mode of Automation Operation Program for the AC motor drive. The Automation Operation Program can be applied for any external controls, relays or switches. The AC motor drive changes speeds and directions according to your desired programming.

When this parameter is set to 5 and it is running by external multi-speed, the highest priority of the operation direction is P12.41.

Example 1 (P12.40 = 1)

Execute one cycle of the Automation Operation Program. Related parameter settings are:

- *P04.00–04.06: 1st to 7th step speed (sets the frequency of each step speed).*
- *P02.01–02.05: Multi-Function Input Terminals (set one multi-function terminal as 94-Programmable AUTO RUN).*
- *P.02.13–02.16: Multi-Function Output Terminals (set a Multi-Function Terminal as 77-program running indication, 78-Program Step Completed Indication or 79-Program Running Completed Indication).*
- *P12.40:* Automation Operation Program *mode.*
- *P12.41: Direction of operation for Master Frequency and1st to 7th step speed.*
- *P12.42–12.49: Operation time setting of Master Frequency and 1st to 7th step speed.*

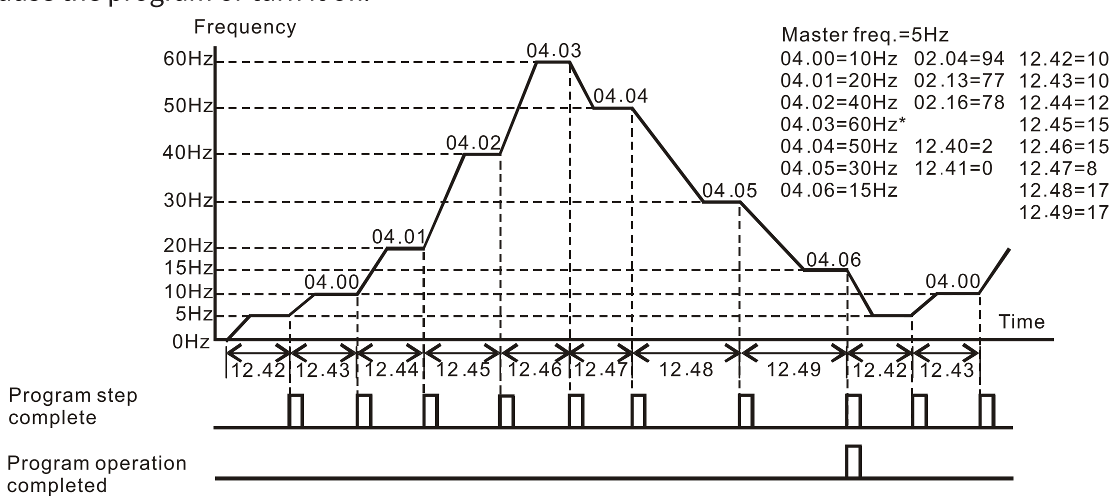


The diagram above shows one complete Automation Operation Program cycle. To restart the cycle, turn the Automation Operation Program off (P12.40=0) and then turn back on.

Example 2 (P12.40 = 2)

Continuously executes Automation Operation Program cycles.

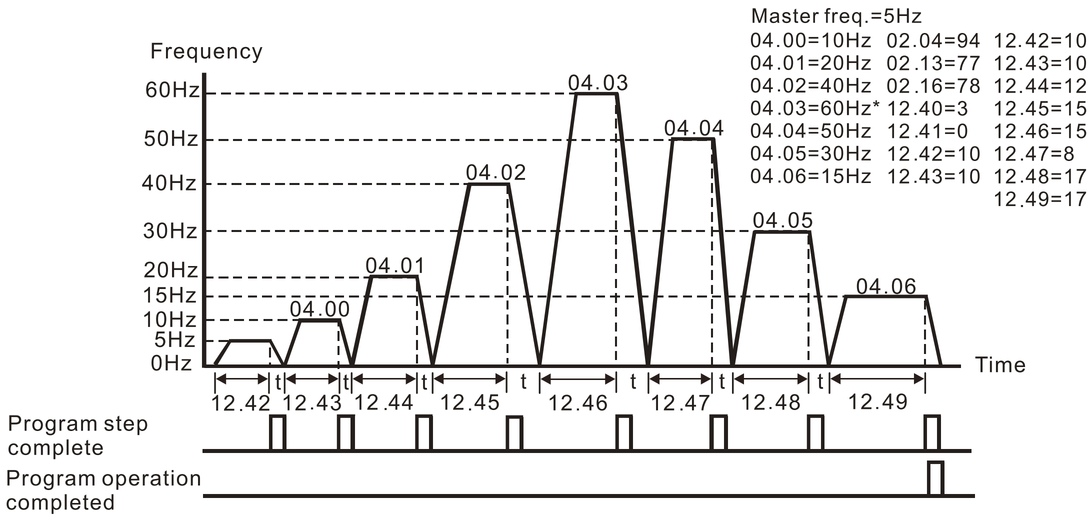
The diagram below shows the Automation Operation Program stepping through each speed and then automatically starting again. To stop the Automation Operation Program, you must either pause the program or turn it off.



Example 3 (P12.40 = 3)

Execute one program cycle step by step.

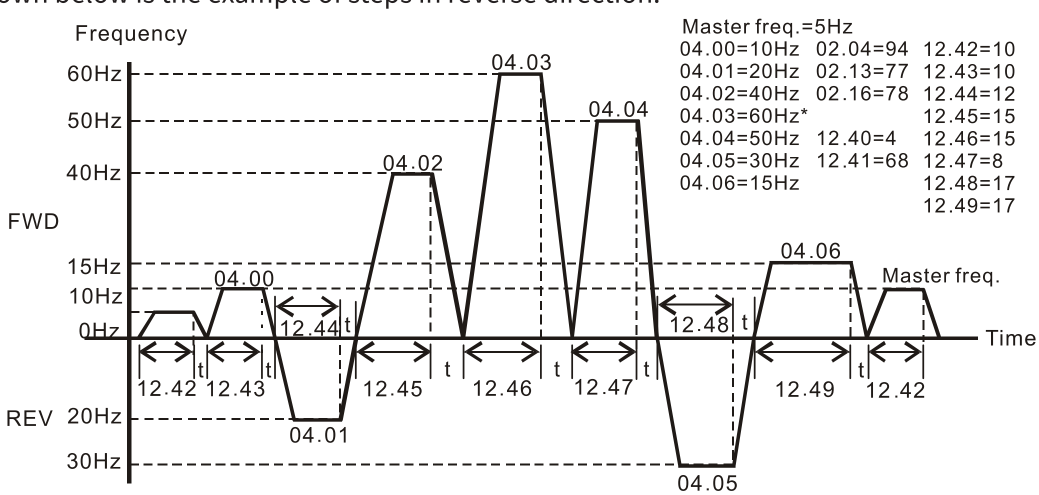
The example shows how the Automation Operation Program executes one program cycle at a time within a complete cycle. Each step uses the acceleration/deceleration time. Note that the time each step spends at its desired frequency reduces due to the time spent during acceleration/deceleration.



Example 4 (P12.40 = 4)

Continuously execute Automation Operation Program cycles step by step.

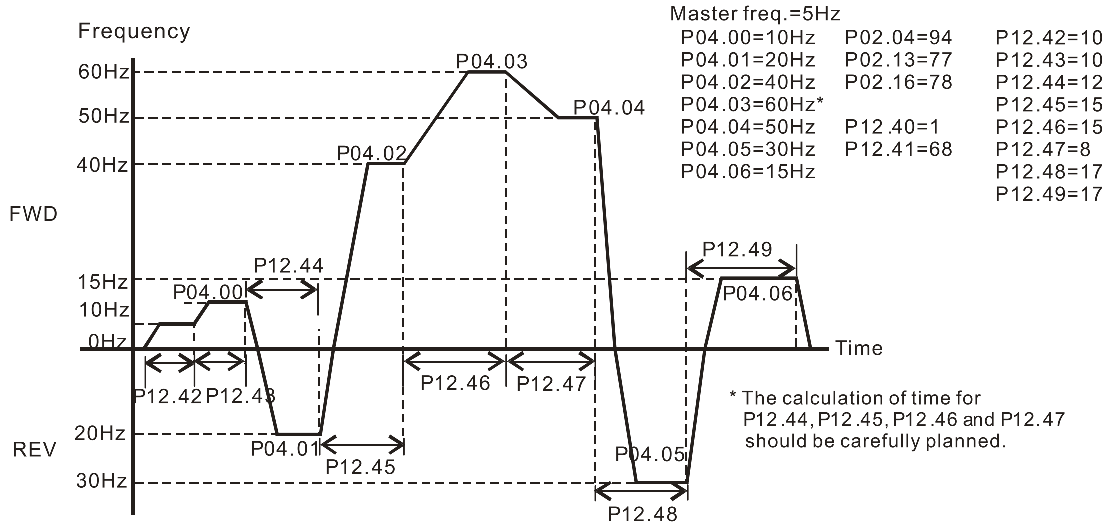
In this example, Automation Operation Program runs continuously step by step. The diagram shown below is the example of steps in reverse direction.



Example 5 (P12.40=1)

Execute one cycle of the Automation Operation Program.

In this example, the Automation Operation Program runs continuously. Noted that the times of reserve motion may be shorter than expected due to the acceleration/deceleration time.



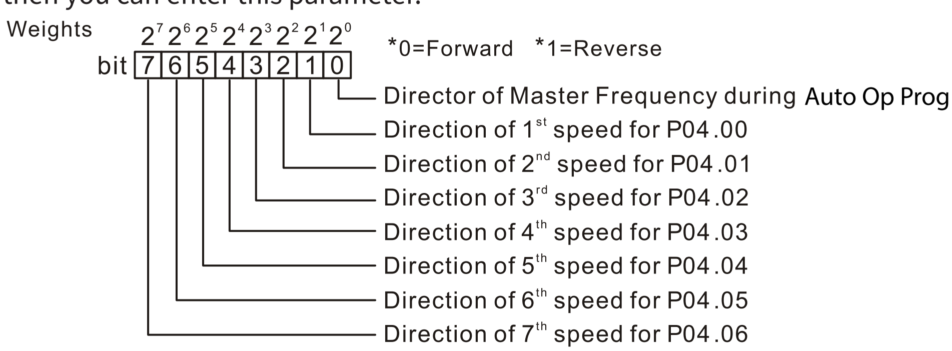
		Type	Hex Addr	Dec Addr
P12.41	***Automation Operation Program Running Direction Mode***	R/W	0C29	43114

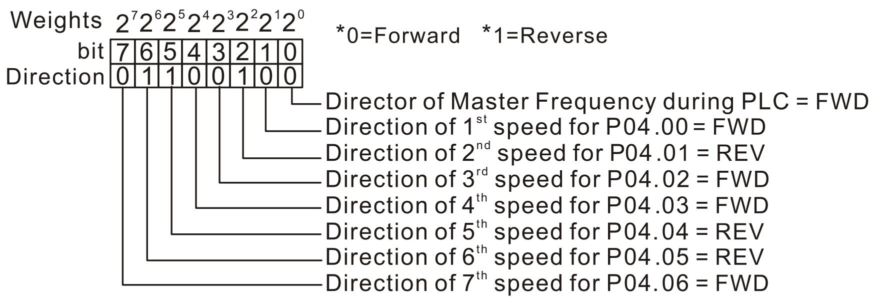
Range/Units (Format: 16-bit binary) — *Default*: 0

bit 0–bit 7 (0: FWD RUN, 1: REV RUN)
bit 0: Direction of auto-operation's main speed
bit 1: Direction of the first speed for Pr.04-00
bit 2: Direction of the second speed for Pr.04-01
bit 3: Direction of the second speed for Pr.04-02
bit 4: Direction of the second speed for Pr.04-03
bit 5: Direction of the second speed for Pr.04-04
bit 6: Direction of the second speed for Pr.04-05
bit 7: Direction of the second speed for Pr.04-06

P12.41 controls the direction of motion for the Multi-Step Speed P04.00 to P04.06 and the Master Frequency. The original direction of Master Frequency will become invalid.

The equivalent 8-bit number is used to program the forward/reverse motion for each of the 8 speed steps (including Master Frequency). The binary 8-bit number must convert to decimal, and then you can enter this parameter.





The setting value

$= bit7 \times 2^7 + bit6 \times 2^6 + bit5 \times 2^5 + bit4 \times 2^4 + bit3 \times 2^3 + bit2 \times 2^2 + bit1 \times 2^1 + bit0 \times 2^0$

$= 0 \times 2^7 + 1 \times 2^6 + 1 \times 2^5 + 0 \times 2^4 + 0 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 0 \times 2^0$

$= 0+64+32+16+0+0+2+0$

$= 100$ Setting P12.41 = 100

$2^0=1$	$2^3=8$	$2^6=64$
$2^1=2$	$2^4=16$	$2^7=128$
$2^2=4$	$2^5=32$	

		Type	Hex Addr	Dec Addr
P12.42	***Main Frequency Time Setting***	R/W	0C2A	43115
P12.43	***1st Speed Time Setting***	R/W	0C2B	43116
P12.44	***2nd Speed Time Setting***	R/W	0C2C	43117
P12.45	***3rd Speed Time Setting***	R/W	0C2D	43118
P12.46	***4th Speed Time Setting***	R/W	0C2E	43119
P12.47	***5th Speed Time Setting***	R/W	0C2F	43120
P12.48	***6th Speed Time Setting***	R/W	0C30	43121
P12.49	***7th Speed Time Setting***	R/W	0C31	43122

Range/Units (Format: 16-bit binary)	Default
0–65500 seconds	0

P12.42 to P12.49 correspond to the operation time for each multi-step speed defined.

The maximum value for these parameters is 65500 seconds, and it displays as 65.5.

If it is set to 0 (0 sec.), the corresponding step skips. This is commonly used to reduce number of program steps.

		Type	Hex Addr	Dec Addr
P12.51	***Average PWM Signal***	♦R/W	0C33	43124

Range/Units (Format: 16-bit binary)	Default
1–100 times	1

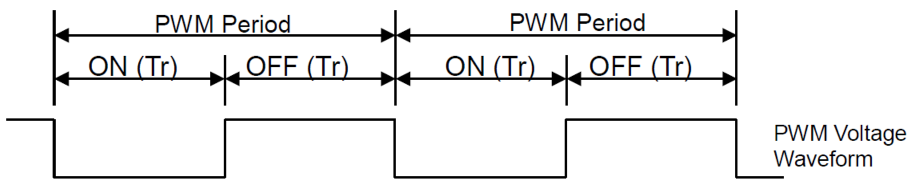
P12.51 calculates the corresponding frequency command based on the average values according to the set number of times for PWM signal period. The smaller the number of times set, the faster the frequency changes.

		Type	Hex Addr	Dec Addr
P12.52	***PWM Signal Period***	♦R/W	0C34	43125
	Range/Units (Format: 16-bit binary)	*Default*		

P12.52 sets the period for PWM signal input.

GS10 can control the operation frequency of the drive through PWM/pulse signal outputted from devices such as PLC; however, PWM signal can only be input from DI5. You must set the Master frequency command (AUTO) source P00.20 to 4 (Pulse input without direction command) and set pulse input type P10.16 to 6 (PWM signal input). P12.51 sets how long the PWM outputs a command after how many times of averaging and sets the period of external PWM. The corresponding output frequency calculates according to the settings for these two parameters.

- *When the actual input PWM pulse signal period is different from P12.52 setting, the output frequency calculates incorrectly.*
- *The relationship between PWM signal and frequency command shows as the diagram below:*



Frequency command value (Hz) = (ON time / PWM period) × the maximum output frequency (Hz).

Group P13.xx Details – Macro / User Defined Parameters

		Type	Hex Addr	Dec Addr
P13.00	***Industry-specific Parameter Application***	R/W	0D0D	43329
	Range/Units (Format: 16-bit binary)	*Default*		
	00: Disabled 01: User-defined parameter 03: Fan 04: Pump 05: Conveyor 07: Packing 10: Logistics 11: Tension PID 12: Tension PID + master / auxiliary frequency	00		

NOTE: : After you select the macro, some of the default values adjust automatically according to the application selection. If P13.00 is set to a macro selection, the drive must be set back to defaults (P00.02 =10) to revert all parameters to the original parameter settings.

P13.00=03: Fan

The following table lists the relevant fan setting application parameters.

Parameter	Parameter Name	Settings
P00.11	Speed control mode	0 (IMVF)
P00.16	Load selection	0 (Variable torque)
P00.17	Carrier frequency	Default setting
P00.20	Master frequency command source (AUTO, REMOTE)	2 (External analog input)
P00.21	Operation command source (AUTO, REMOTE)	1 (External terminals)
P00.22	Stop method	1 (Coast to stop)
P00.23	Motor direction control	1 (Disable reverse)
P00.30	Master frequency command source (HAND, LOCAL)	0 (Digital keypad)
P00.31	Operation command source (HAND, LOCAL)	0 (Digital keypad)
P01.00	Maximum operation frequency	Default setting
P01.01	Output frequency of motor 1 (Base frequency / Motor's rated frequency)	Default setting
P01.02	Output voltage of motor 1 (Base voltage / Motor's rated voltage)	Default setting
P01.03	Mid-point frequency 1 of motor 1	Default setting
P01.04	Mid-point voltage 1 of motor 1	Default setting
P01.05	Mid-point frequency 2 of motor 1	Default setting
P01.06	Mid-point voltage 2 of motor 1	Default setting
P01.07	Minimum output frequency of motor 1	Default setting
P01.08	Minimum output voltage of motor 1	Default setting
P01.10	Output frequency upper limit	50 (Hz)
P01.11	Output frequency lower limit	35 (Hz)
P01.12	Acceleration time 1	15 (sec.)
P01.13	Deceleration time 1	15 (sec.)
P01.43	V/F curve selection	2 (V/F curve to the power of 2)
P02.05	Multi-function input command 5 (DI5)	16 (Rotating speed command from AI-C)
P02.16	Multi-function output 2 (DO1)	11 (Malfunction indication)

Parameter	Parameter Name	Settings
P03.00	Analog input selection (AI)	1 (Frequency command)
P03.28	AI terminal input selection	0 (0–10 V)
P03.50	Analog input curve selection	1 (three-point curve of AI-V)
P07.06	Restart after momentary power loss	2 (Speed tracking by the minimum output frequency)
P07.11	Number of times of restart after fault	5 (times)
P07.33	Auto-restart interval of fault	60 (sec.)

P13.00=04: Pump

The following table lists the relevant pump setting application parameters.

Parameter	Parameter Name	Settings
P00.11	Speed control mode	0 (IMVF)
P00.16	Load selection	0 (Variable torque)
P00.20	Master frequency command source (AUTO, REMOTE)	2 (External analog input)
P00.21	Operation command source (AUTO, REMOTE)	1 (External terminals)
P00.23	Motor direction control	1 (Disable reverse)
P01.00	Maximum operation frequency	Default setting
P01.01	Output frequency of motor 1 (Base frequency / Motor's rated frequency)	Default setting
P01.02	Output voltage of motor 1 (Base voltage / Motor's rated voltage)	Default setting
P01.03	Mid-point frequency 1 of motor 1	Default setting
P01.04	Mid-point voltage 1 of motor 1	Default setting
P01.05	Mid-point frequency 2 of motor 1	Default setting
P01.06	Mid-point voltage 2 of motor 1	Default setting
P01.07	Minimum output frequency of motor 1	Default setting
P01.08	Minimum output voltage of motor 1	Default setting
P01.10	Output frequency upper limit	50 (Hz)
P01.11	Output frequency lower limit	35 (Hz)
P01.12	Acceleration time 1	15 (sec.)
P01.13	Deceleration time 1	15 (sec.)
P01.43	V/F curve selection	2 (V/F curve to the power of 2)
P07.06	Restart after momentary power loss	2 (Speed tracking by the minimum output frequency)
P07.11	Number of times of restart after fault	5 (times)
P07.33	Auto-restart interval of fault	60 (sec.)

P13.00=05: Conveyor

The following table lists the relevant conveyor setting application parameters.

Parameter	Parameter Name	Settings
P00.11	Speed control mode	0 (IMVF)
P00.16	Load selection	0 (Variable torque)
P00.20	Master frequency command source (AUTO, REMOTE)	2 (External analog input)
P00.21	Operation command source (AUTO, REMOTE)	1 (External terminals)
P01.00	Maximum operation frequency	Default setting

Parameter	Parameter Name	Settings
P01.01	Output frequency of motor 1 (Base frequency / Motor's rated frequency)	Default setting
P01.02	Output voltage of motor 1 (Base voltage / Motor's rated voltage)	Default setting
P01.03	Mid-point frequency 1 of motor 1	Default setting
P01.04	Mid-point voltage 1 of motor 1	Default setting
P01.05	Mid-point frequency 2 of motor 1	Default setting
P01.06	Mid-point voltage 2 of motor 1	Default setting
P01.07	Minimum output frequency of motor 1	Default setting
P01.08	Minimum output voltage of motor 1	Default setting
P01.12	Acceleration time 1	10 (sec.)
P01.13	Deceleration time 1	10 (sec.)

P13.00=07: Packing

The following table lists the relevant compressor setting application parameters.

Parameter	Parameter Name	Settings
P00.11	Speed control mode	0 (IMVF)
P00.20	Master frequency command source (AUTO, REMOTE)	0 (Digital keypad)
P00.21	Operation command source (AUTO, REMOTE)	2 (RS-485 communication input)
P02.00	Two-wire / three-wire operation control	1 (two-wire mode 1, power on for operation control (D1: FWD / STOP, D2: REV / STOP))
P01.00	Maximum operation frequency	Default setting
P01.01	Output frequency of motor 1 (Base frequency / Motor's rated frequency)	Default setting
P01.02	Output voltage of motor 1 (Base voltage / Motor's rated voltage)	Default setting
P01.03	Mid-point frequency 1 of motor 1	Default setting
P01.04	Mid-point voltage 1 of motor 1	Default setting
P01.05	Mid-point frequency 2 of motor 1	Default setting
P01.06	Mid-point voltage 2 of motor 1	Default setting
P01.07	Minimum output frequency of motor 1	Default setting
P01.08	Minimum output voltage of motor 1	Default setting
P01.12	Acceleration time 1	10 (sec.)
P01.13	Deceleration time 1	10 (sec.)
P01.24	S-curve for acceleration begin time 1	Default setting
P01.25	S-curve for acceleration arrival time 2	Default setting
P01.26	S-curve for deceleration begin time 1	Default setting
P01.27	S-curve for deceleration arrival time 2	Default setting
P03.00	Analog input selection (AI)	1 (Frequency command)
P03.28	AI terminal input selection	Default setting

P13.00=10: Logistics

The following table lists the relevant logistics setting application parameters.

Parameter	Parameter Name	Settings
P00.20	Master frequency command source (AUTO, REMOTE)	7 (Digital keypad VR/potentiometer dial)
P00.21	Operation command source (AUTO, REMOTE)	1 (External terminals)
P01.00	Maximum operation frequency	Default setting
P01.01	Output frequency of motor 1 (Base frequency / Motor's rated frequency)	Default setting
P01.02	Output voltage of motor 1 (Base voltage / Motor's rated voltage)	400.0
P01.04	Mid-point voltage 1 of motor 1	20.0
P01.06	Mid-point voltage 2 of motor 1	20.0
P01.08	Minimum output voltage of motor 1	20.0
P01.03	Mid-point frequency 1 of motor 1	1.50
P01.07	Minimum output frequency of motor 1	1.50
P01.12	Acceleration time 1	3 (sec.)
P01.13	Deceleration time 1	3 (sec.)
P01.24	S-curve for acceleration begin time 1	0.00
P01.25	S-curve for acceleration arrival time 2	0.00
P01.26	S-curve for deceleration begin time 1	0.00
P01.27	S-curve for deceleration arrival time 2	0.00
P06.03	Over-current stall prevention during acceleration	200
P06.04	Over-current stall prevention during operation	200
P06.05	Acceleration / deceleration time selection for stall prevention at constant speed	2: By the second acceleration / deceleration time
P07.23	Automatic voltage regulation (AVR) function	1: Disable AVR
P07.26	Torque compensation gain	0

P13.00=11: PID

The following table lists the relevant PID setting application parameters.

Parameter	***Parameter Name***	***Settings***
P00.20	Master frequency command source (AUTO, REMOTE)	9 (PID controller)
P00.21	Operation command source (AUTO, REMOTE)	1 (External terminals)
P01.00	Maximum operation frequency	Default setting
P01.12	Acceleration time 1	3 (sec.)
P01.13	Deceleration time 1	3 (sec.)
P03.00	Analog input selection (AI)	5 (PID feedback signal)
P03.50	Analog input curve selection	1: Three-point curve of AI-V
P03.63	AI-V voltage lowest point	0.00
P03.65	AI-V voltage mid-point	9.99
P03.66	AI-V proportional mid-point	100%
P08.00	Terminal selection of PID feedback	1: Negative PID feedback: by analog input (P03.00)
P08.01	Proportional gain (P)	10
P08.02	Integral time (I)	1
P08.20	PID mode selection	1: Parallel connection
P08.21	Enable PID to change the operation direction	0: Operation direction cannot be changed
P08.65	PID target value source	1: P08.66 setting
P08.66	PID target value setting	50%

P13.00=12: Tension PID + Master/Aux Frequency

The following table lists the relevant tension PID setting application parameters.

Parameter	***Parameter Name***	***Settings***
P00.20	Master frequency command source (AUTO, REMOTE)	9 (PID controller)
P00.21	Operation command source (AUTO, REMOTE)	1 (External terminals)
P00.35	Auxiliary frequency source	3: Analog input
P01.00	Maximum operation frequency	Default setting
P01.12	Acceleration time 1	3 (sec.)
P01.13	Deceleration time 1	3 (sec.)
P03.00	Analog input selection (AI-V)	5 (PID feedback signal)
P03.10	Reverse setting when analog signal input is negative frequency	0: Negative frequency input is not allowed. The digital keypad or external terminal controls the forward and reverse direction.
P03.12	Analog input gain (AI-C)	100.0%
P03.50	Analog input curve selection	1: Three-point curve of AI-V
P03.63	AI-V voltage lowest point	0.00
P03.65	AI-V voltage mid-point	9.99
P03.66	AI-V proportional mid-point	100%
P08.00	Terminal selection of PID feedback	1: Negative PID feedback: by analog input (P03.00)
P08.01	Proportional gain (P)	10
P08.02	Integral time (I)	1
P08.20	PID mode selection	1: Parallel connection
P08.21	Enable PID to change the operation direction	0: Operation direction cannot be changed
P08.65	PID target value source	1: P08.66 setting

Parameter	Parameter Name	Settings
P08.66	PID target value setting	50%
P08.67	Master and auxiliary reverse running cutoff frequency	10%

P13.00=1, User-defined Parameters

Parameters 13.01 through 13.50 are blank for your use. You can record any user defined parameter settings here if you wish.

		Type	Hex Addr	Dec Addr
P13.01		♦R/W	0D01	43330
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.02		♦R/W	0D02	43331
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.03		♦R/W	0D03	43332
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.04		♦R/W	0D04	43333
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.05		♦R/W	0D05	43334
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.06		♦R/W	0D06	43335
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.07		♦R/W	0D07	43336
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.08		♦R/W	0D08	43337
	Range/Units (Format: 16-bit unsigned)	Default		

	Type	Hex Addr	Dec Addr
P13.09	♦R/W	0D09	43338
Range/Units (Format: 16-bit unsigned)	*Default*		

	Type	Hex Addr	Dec Addr
P13.10	♦R/W	0D0A	43339
Range/Units (Format: 16-bit unsigned)	*Default*		

	Type	Hex Addr	Dec Addr
P13.11	♦R/W	0D0B	43340
Range/Units (Format: 16-bit unsigned)	*Default*		

	Type	Hex Addr	Dec Addr
P13.12	♦R/W	0D0C	43341
Range/Units (Format: 16-bit unsigned)	*Default*		

	Type	Hex Addr	Dec Addr
P13.13	♦R/W	0D0D	43342
Range/Units (Format: 16-bit unsigned)	*Default*		

	Type	Hex Addr	Dec Addr
P13.14	♦R/W	0D0E	43343
Range/Units (Format: 16-bit unsigned)	*Default*		

	Type	Hex Addr	Dec Addr
P13.15	♦R/W	0D0F	43344
Range/Units (Format: 16-bit unsigned)	*Default*		

	Type	Hex Addr	Dec Addr
P13.16	♦R/W	0D10	43345
Range/Units (Format: 16-bit unsigned)	*Default*		

	Type	Hex Addr	Dec Addr
P13.17	♦R/W	0D11	43346
Range/Units (Format: 16-bit unsigned)	*Default*		

		Type	Hex Addr	Dec Addr
P13.18		♦R/W	0D12	43347
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.19		♦R/W	0D13	43348
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.20		♦R/W	0D14	43349
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.21		♦R/W	0D15	43350
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.22		♦R/W	0D16	43351
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.23		♦R/W	0D17	43352
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.24		♦R/W	0D18	43353
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.25		♦R/W	0D19	43354
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.26		♦R/W	0D1A	43355
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.27		♦R/W	0D1B	43356
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.28		♦R/W	0D1C	43357
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.29		♦R/W	0D1D	43358
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.30		♦R/W	0D1E	43359
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.31		♦R/W	0D1F	43360
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.32		♦R/W	0D20	43361
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.33		♦R/W	0D21	43362
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.34		♦R/W	0D22	43363
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.35		♦R/W	0D23	43364
	Range/Units (Format: 16-bit unsigned)	Default		

	Type	Hex Addr	Dec Addr
P13.36	♦R/W	0D24	43365
Range/Units (Format: 16-bit unsigned)	Default		

	Type	Hex Addr	Dec Addr
P13.37	♦R/W	0D25	43366
Range/Units (Format: 16-bit unsigned)	Default		

	Type	Hex Addr	Dec Addr
P13.38	♦R/W	0D26	43367
Range/Units (Format: 16-bit unsigned)	Default		

	Type	Hex Addr	Dec Addr
P13.39	♦R/W	0D27	43368
Range/Units (Format: 16-bit unsigned)	Default		

	Type	Hex Addr	Dec Addr
P13.40	♦R/W	0D28	43369
Range/Units (Format: 16-bit unsigned)	Default		

	Type	Hex Addr	Dec Addr
P13.41	♦R/W	0D29	43370
Range/Units (Format: 16-bit unsigned)	Default		

	Type	Hex Addr	Dec Addr
P13.42	♦R/W	0D2A	43371
Range/Units (Format: 16-bit unsigned)	Default		

	Type	Hex Addr	Dec Addr
P13.43	♦R/W	0D2B	43372
Range/Units (Format: 16-bit unsigned)	Default		

	Type	Hex Addr	Dec Addr
P13.44	♦R/W	0D2C	43373
Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.45		♦R/W	0D2D	43374
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.46		♦R/W	0D2E	43375
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.47		♦R/W	0D2F	43376
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.48		♦R/W	0D30	43377
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.49		♦R/W	0D31	43378
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.50		♦R/W	0D32	43379
	Range/Units (Format: 16-bit unsigned)	Default		

Group P14.xx Details – Protection Parameters (2)

		Type	Hex Addr	Dec Addr
P14.50	**Output Frequency at Malfunction 2**	Read	0E32	43635
P14.54	**Output Frequency at Malfunction 3**	Read	0E36	43639
P14.58	**Output Frequency at Malfunction 4**	Read	0E3A	43643
P14.62	**Output Frequency at Malfunction 5**	Read	0E3E	43647
P15.66	**Output Frequency at Malfunction 6**	Read	0E42	43651
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.0 Hz	0		

When an error occurs, you can check the output frequency for the malfunction. If the error happens again, this parameter overwrites the previous record.

		Type	Hex Addr	Dec Addr
P14.51	**DC bus Voltage at Malfunction 2**	Read	0E33	43636
P14.55	**DC bus Voltage at Malfunction 3**	Read	0E37	43640
P14.59	**DC bus Voltage at Malfunction 4**	Read	0E3B	43644
P14.63	**DC bus Voltage at Malfunction 5**	Read	0E3F	43648
P14.67	**DC bus Voltage at Malfunction 6**	Read	0E43	43652
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–6553.5 V	0		

When an error occurs, you can check the DC bus voltage for the malfunction. If the error happens again, this parameter overwrites the previous record.

		Type	Hex Addr	Dec Addr
P14.52	**Output Current at Malfunction 2**	Read	0E34	43637
P14.56	**Output Current at Malfunction 3**	Read	0E38	43641
P14.60	**Output Current at Malfunction 4**	Read	0E3C	43645
P14.64	**Output Current at Malfunction 5**	Read	0E40	43649
P14.68	**Output Current at Malfunction 6**	Read	0E44	43653
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–655.35 Amps	0		

When an error occurs, you can check the output current for the malfunction. If the error happens again, this parameter overwrites the previous record.

		Type	Hex Addr	Dec Addr
P14.53	**IGBT Temperature at Malfunction 2**	Read	0E35	43638
P14.57	**IGBT Temperature at Malfunction 3**	Read	0E39	43642
P14.61	**IGBT Temperature at Malfunction 4**	Read	0E3D	43646
P14.65	**IGBT Temperature at Malfunction 5**	Read	0E41	43650
P14.69	**IGBT Temperature at Malfunction 6**	Read	0E45	43654
	Range/Units (Format: 16-bit signed)	*Default*		
	-3276.7–3276.7 °C	0		

When an error occurs, you can check the IGBT temperature for the malfunction. If the error happens again, this parameter overwrites the previous record.

		Type	Hex Addr	Dec Addr
P14.70	***Fault Record 7***	Read	0E46	43655
P14.71	***Fault Record 8***	Read	0E47	43656
P14.72	***Fault Record 9***	Read	0E48	43657
P14.73	***Fault Record 10***	Read	0E49	43658

Range/Units (Format: 16-bit unsigned) — *Default*: 0

Settings
0: No fault record
1: Over-current during acceleration (ocA)
2: Over-current during deceleration (ocd)
3: Over-current during steady operation (ocn)
4: Ground fault (GFF)
6: Over-current at STOP (ocS)
7: Over-voltage during acceleration (ovA)
8: Over-voltage during deceleration (ovd)
9: Over-voltage during constant speed (ovn)
10: Over-voltage at stop (ovS)
11: Low-voltage during acceleration (LvA)
12: Low-voltage during deceleration (Lvd)
13: Low-voltage during constant speed (Lvn)
14: Low-voltage at stop (LvS)
15: Phase loss protection (orP)
16: IGBT overheating (oH1)
18: IGBT temperature detection failure (tH1o)
21: Over load (oL)
22: Electronics thermal relay 1 protection (EoL1)
23: Electronics thermal relay 2 protection (EoL2)
24: Motor PTC overheating (oH3)
26: Over-torque 1 (ot1)
27: Over-torque 2 (ot2)
28: Under current (uC)
31: EEPROM read error (cF2)
33: U-phase error (cd1)
34: V-phase error (cd2)
35: W-phase error (cd3)
36: cc (current clamp) hardware error (Hd0)
37: oc (over-current) hardware error (Hd1)
40: Auto-tuning error (AUE)
41: PID loss AI-C (AFE)
48: AI-C loss (ACE)
49: External fault (EF)
50: Emergency stop (EF1)
51: External Base Block (bb)
52: Password is locked (Pcod)
54: Illegal command (CE1)
55: Illegal data address (CE2)
56: Illegal data value (CE3)
57: Data is written to read-only address (CE4)
58: Modbus transmission time-out (CE10)

63: Over slip error (oSL)
82: Output phase loss U phase (oPL1)
83: Output phase loss V phase (oPL2)
84: Output phase loss W phase (oPL3)
87: Low frequency overload protection (oL3)
142: Auto-tune error 1 (DC test stage) (AuE1)
143: Auto-tune error 2 (High frequency test stage) (AuE2)
149: Total resistance measurement fault (AUE5)
150: No-load current IO measurement fault (AUE6)
151: dq axis inductance measurement fault (AUE7)
152: High frequency injection measurement fault (AUE8)
157: Pump PID feedback error (dEv)

The parameters record when the fault occurs and forces a stop.

- *When low-voltage at stop fault (LvS) occurs, the fault is not recorded. When low-voltage during operation faults (LvA, Lvd, Lvn) occur, the faults are recorded.*
- *When the dEb function is valid and enabled, the drive executes dEb and records fault code 62 to P06.17–P06.22 and P14.70–P14.73 simultaneously.*

Adjustments and Applications

This section provides step-by-step information on how to optimize the GS10 speed control mode. These procedures are not required for advanced speed control, but will ensure your drive and motor perform at the highest level.

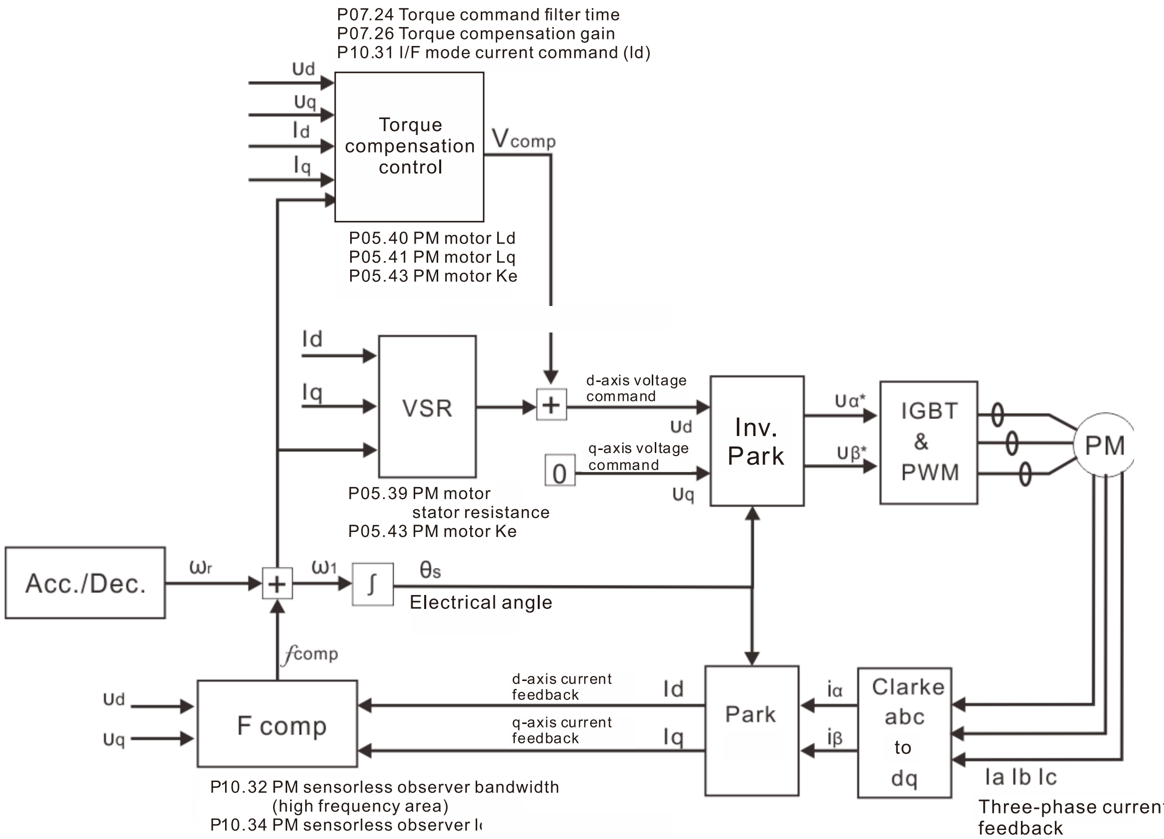
The following procedure can be found in this section:

- *PMSVC mode with permanent magnet motor (PM) adjustment procedure.*

PMSVC mode with permanent magnet motor (PM) adjustment procedure

When P00.11 Speed Control Mode = 2 SVC (P05.33 = 1 or 2)

PMSVC control diagram



NOTE: In the diagram, "PM motor" means "permanent magnet synchronous AC motor".

NOTE: Once PMSVC adjustment procedure is complete, cycle power to the GS10 drive.

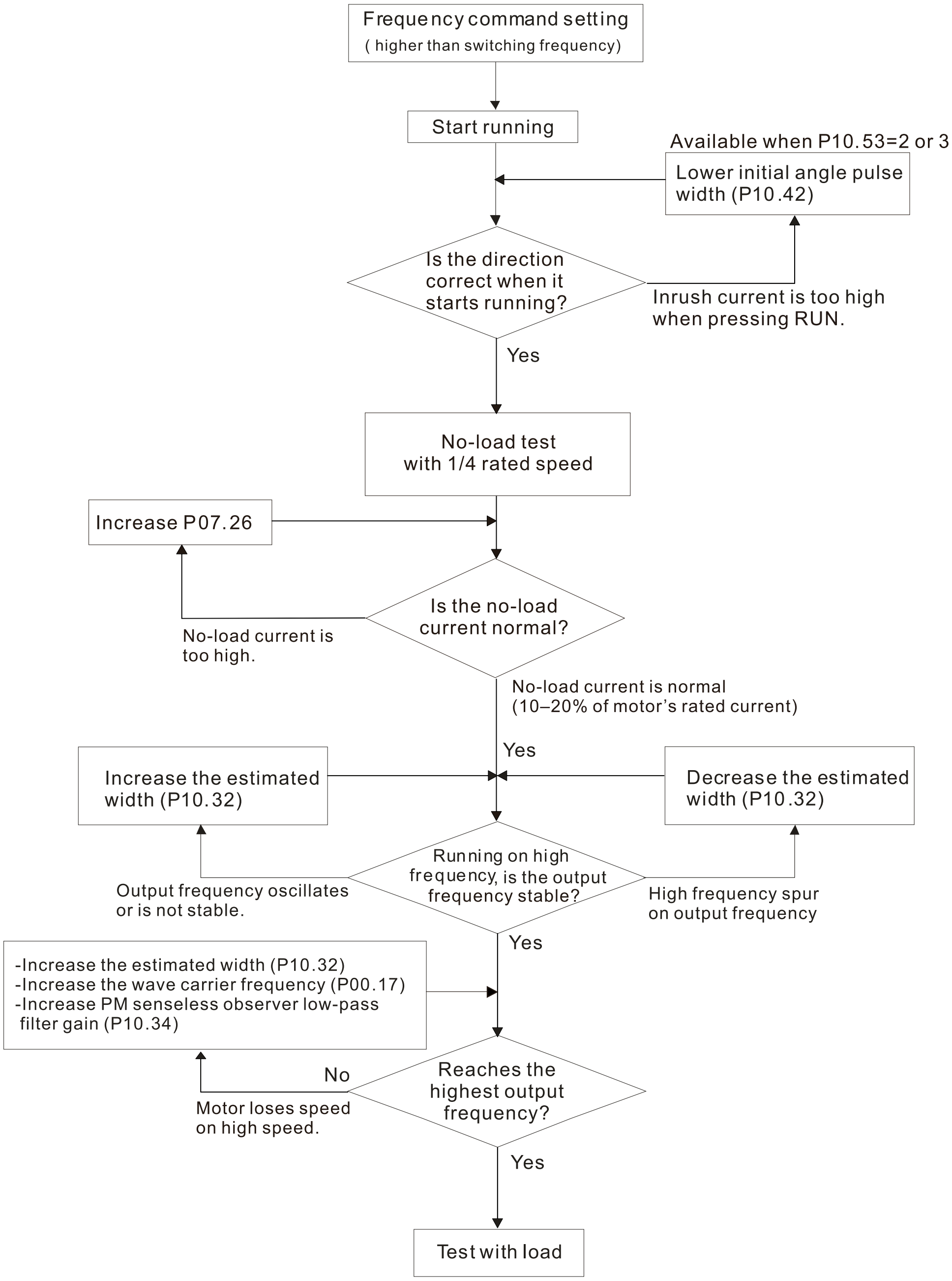
Adjustment procedure

1) Select PM synchronous AC motor control.
   P05.33 Induction Motor (IM) or Permanent Magnet (PM) Synchronous AC Motor Selection =1 (SPM) or 2 (IPM)
2) Set up motor parameters according to the motor's nameplate
   - *P01.01: Rated frequency*
   - *P01.02: Rated voltage*
   - *P05.34: Rated current*
   - *P05.35: Rated Power*
   - *P05.36: Rated speed*

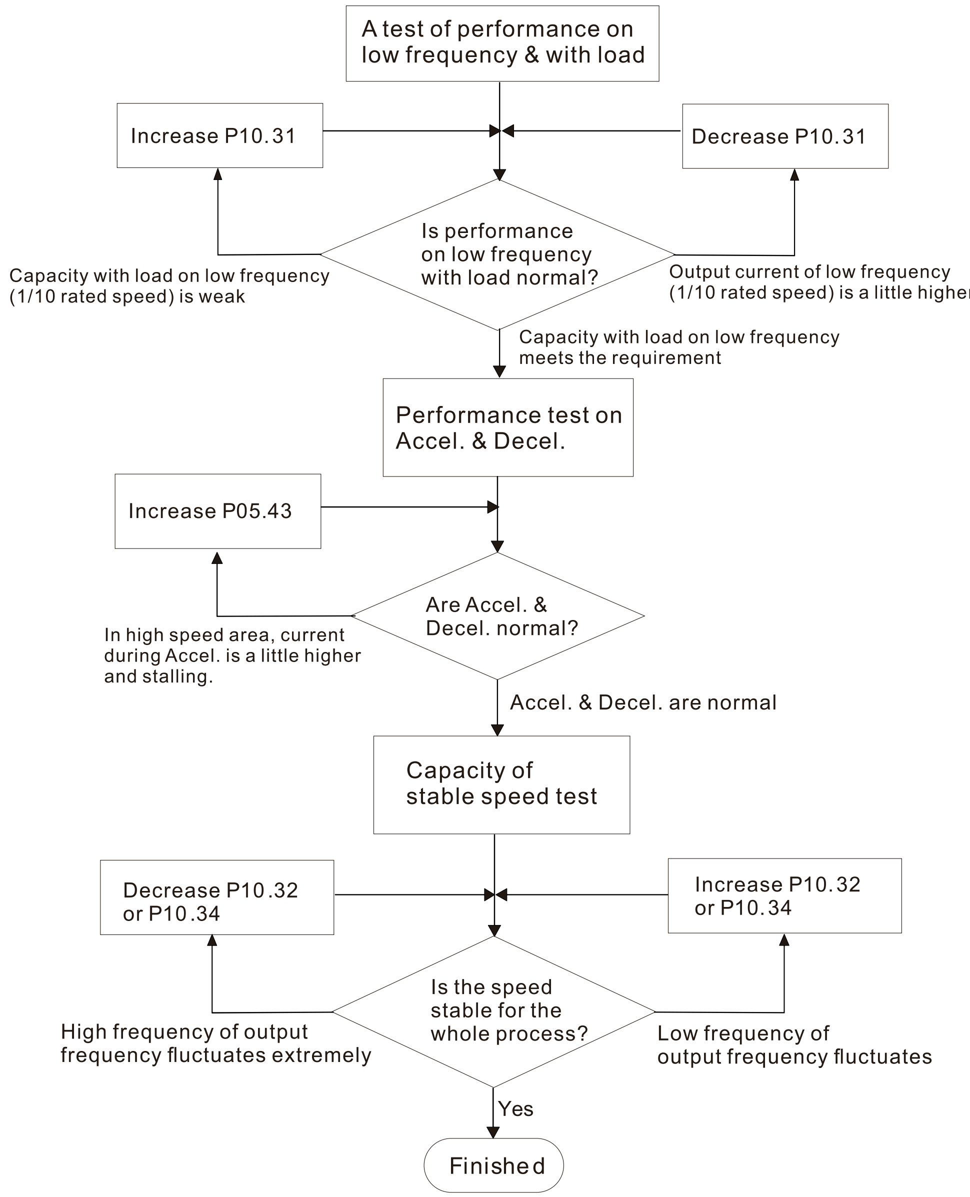
- *P05.37: Number of poles for the motor*

3) Execute PM synchronous AC motor auto-tuning (static)
   a) Set P05.00 Motor Parameter Auto-tuning = 5 or 13, and press RUN.
   b) When you finish tuning, the following parameters are available:
      - *P05.39: Stator resistance*
      - *P05.40: Permanent magnet synchronous AC motor Ld*
      - *P05.41: Permanent magnet synchronous AC motor lq*
      - *P05.43: (V / 1000 rpm), the Ke parameter of PM synchronous AC motor (you can calculate this automatically according to power, current, and speed of the motor).*
4) Set the speed control mode: P00.11 Speed Control Mode = 2 SVC.
5) Cycle the power after you finish tuning.
6) The ratio of the PMSVC control mode is 1:20.
7) When the PMSVC control mode is under 1/20th of the rated speed, the load bearing capacity is 100% of the motor rated torque.
8) PMSVC control mode is not applicable to zero speed control.
9) The start-up load and the load bearing capacity of the forward/reverse running in PMSVC control mode equal to 100% of the motor rated torque.

10) Adjustment flow chart when starting WITHOUT load:



11) Adjustment flow chart when starting WITH load:



12) Set up the related parameters for speed estimators
- *P10.31, I/F Mode, Current Command*
- *P10.32, PM Sensorless Speed Estimator Bandwidth*
- *P10.34, PM Sensorless Speed Estimator Low-pass Filter Gain*
- *P10.39, Frequency Point to Switch from I/F Mode to PM Sensorless Mode*
- *P10.42, Initial Angle Detection Pulse Value*
- *P10.49, Zero Voltage Time during Start-up*
- *P10.51, Injection Frequency*
- *P10.52, Injection Magnitude*
- *P10.53, Angle Detection Method*
- *P07.26, Torque Compensation Gain*

13) After PMSVC setup is complete, cycle power to the GS10 drive.

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PAGE

Serial Communications

Chapter 5

Table of Contents

Communications Parameters Summary

A summary of the GS10 AC drives Communications Parameters is listed below. Refer to "Parameters" Chapter 4 for a complete listing of all GS10 AC drives parameters, including details and Modbus addresses.

Summary – Serial Communication Parameters

GS10 Parameters Summary – Communication Parameters (P09.xx)							
Parameter		Range	Run1) Read/ Write	Modbus Address Hex	Dec	Settings Default2)	User
1) ♦ in the Run-Read/Write column indicates that the parameter can be set during RUN mode. R/W indicates "Read/write." Read indicates "Read-only." 2) Parameters can be restored to their default values using P00.02.							
P09.00	Communication address	1–254	♦R/W	0900	42305	1	
P09.01	COM1 transmission speed	4.8–38.4 Kbps	♦R/W	0901	42306	38.4	
P09.02	COM1 transmission fault treatment	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning, no fault, and continue operation	♦R/W	0902	42307	3	
P09.03	COM1 time-out detection	0.0–100.0 sec.	♦R/W	0903	42308	0.0	
P09.04	COM1 communication protocol	1: 7, N, 2 (ASCII) 2: 7, E, 1 (ASCII) 3: 7, O, 1 (ASCII) 4: 7, E, 2 (ASCII) 5: 7, O, 2 (ASCII) 6: 8, N, 1 (ASCII) 7: 8, N, 2 (ASCII) 8: 8, E, 1 (ASCII) 9: 8, O, 1 (ASCII) 10: 8, E, 2 (ASCII) 11: 8, O, 2 (ASCII) 12: 8, N, 1 (RTU) 13: 8, N, 2 (RTU) 14: 8, E, 1 (RTU) 15: 8, O, 1 (RTU) 16: 8, E, 2 (RTU) 17: 8, O, 2 (RTU)	♦R/W	0904	42309	13	
P09.09	Communication response delay time	0.0–200.0 ms	♦R/W	0909	42314	2.0	
P09.10	Communication main frequency	0.00–599.00 Hz	R/W	090A	42315	60.00	
P09.11	Block transfer 1	0–65535	♦R/W	090B	42316	0	
P09.12	Block transfer 2	0–65535	♦R/W	090C	42317	0	
P09.13	Block transfer 3	0–65535	♦R/W	090D	42318	0	
P09.14	Block transfer 4	0–65535	♦R/W	090E	42319	0	
P09.15	Block transfer 5	0–65535	♦R/W	090F	42320	0	
P09.16	Block transfer 6	0–65535	♦R/W	0910	42321	0	
P09.17	Block transfer 7	0–65535	♦R/W	0911	42322	0	
P09.18	Block transfer 8	0–65535	♦R/W	0912	42323	0	
P09.19	Block transfer 9	0–65535	♦R/W	0913	42324	0	
P09.20	Block transfer 10	0–65535	♦R/W	0914	42325	0	
P09.21	Block transfer 11	0–65535	♦R/W	0915	42326	0	
P09.22	Block transfer 12	0–65535	♦R/W	0916	42327	0	
P09.23	Block transfer 13	0–65535	♦R/W	0917	42328	0	
P09.24	Block transfer 14	0–65535	♦R/W	0918	42329	0	

GS10 Parameters Summary - Serial Communication Parameters (P09.xx) - (continued)							
Parameter		Range	Run[1] Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default[2]	User
P09.25	Block transfer 15	0–65535	♦R/W	0919	42330	0	
P09.26	Block transfer 16	0–65535	♦R/W	091A	42331	0	
P09.30	Communication decoding method	0: Decoding method 1 1: Decoding method 2	R/W	091E	42335	1	

Block Transfer Explanation

Block Transfer allows Parameters from many different Parameter Groups to be consolidated into one (or fewer) Modbus communication messages. This can greatly simplify PLC programming and reduce network traffic.

The Block Transfer parameters are P09.11 through P09.26. To use these parameters, enter the value of another parameter you wish to read or write through the keypad or GSoft2 configuration software. The parameter values must be converted by adding the upper byte value to the lower byte value, convert the sum to hex, then convert the hex to decimal.

Example:

Parameter P02.22. 0200 + 16 (hex of 22) = 0x0216 = result is 534. 534 is what would be entered in the Block Transfer parameter to read or write parameter P02.22.

Examples of Block Transfer are below:

1) Block transfer 1 (P09.11) = 0000 (AC Motor drive identity code). A Modbus read of P09.11 results in a value of 104. In this case, the drive is model # GS11-11P0 and corresponds to the value 104 in Parameter P00.00.
2) Block transfer 2 (P09.12) = 0006 (Firmware version). A Modbus read of P09.12 results in a value of 100. This is the firmware version of the GS10 drive.
3) Block transfer 3 (P09.13) = 8448 (decimal value of 0x2100 Status Monitor 1). A Modbus read of P09.13 returns the current status of Status Monitor 1.
4) Block transfer 4 (P09.14) = 8449 (decimal value of 0x2101 Status Monitor 2). A Modbus read of P09.14 returns the current status of Status Monitor 2.
5) Block transfer 5 (P09.15) = 8451 (decimal value of 0x2103 Output Frequency). A Modbus read of P09.15 returns the current running frequency of the GS10.
6) Block transfer 6 (P09.16) = 0268 (Acceleration time 1 is parameter P01.12. 12 = 0x0c. 0100 + 0c = 0x010C = 0268 decimal). A Modbus write to P09.16 will set the Acceleration time 1 value.
7) Block transfer 7 (P09.17) = 0269 (Deceleration time 1 is parameter P01.13. 13 = 0x0d. 0100 + 0d = 0x010d = 0269 decimal). A Modbus write to P09.17 will set the Deceleration time 1 value.
8) Block transfer 8 (P09.18) = 8192 (Control Word 1 (Run, Stop, etc…) is 0x2000 = 8192). A Modbus write to P09.18 will control the Run/Stop of the drive along with other items.
9) Block transfer 9 (P09.19) = 8193 (Control Word 2 (Frequency Command) is 0x2001 = 8193). A Modbus write to P09.19 will control the commanded Frequency of the drive.

Accessing all of the registers above would typically take about 6 Modbus messages but by blocking them together in the Block Transfer parameters, we can access everything with 1 read and 1 write.

Serial Modbus Status Addresses

The *DURAPULSE* GS10 AC drive has status memory addresses that are used to monitor the AC drive. For complete listing, see page 4–195.

Status Addresses (Read Only)

GS10 Addresses						
Description		***Range***		***Modbus Address***		
				Hex	***Dec***	***Octal***
Status Monitor 1 Read Only	Error Codes	0: No Error 1: Overcurrent during Accel (ocA) 2: Overcurrent during Decel (ocd) 3: Overcurrent during normal speed (ocn) 4: Ground Fault (GFF) 6: Overcurrent during Stop (ocS) 7: Overvoltage during Accel (ovA) 8: Overvoltage during Decel (ovd) 9: Overvoltage during normal speed (ovn) 10: Overvoltage during Stop (ovS) 11: Low voltage during Accel (LvA) 12: Low voltage during Decel (Lvd) 13: Low voltage during normal speed (Lvn) 14: Low voltage during Stop (LvS) 15: Input phase loss (OrP) 16: IGBT Overheat (oH1) 18: IGBT temperature detection failure (tH1o) 21: Overload (oL) (150% 1Min, Inverter) 22: Motor1 Thermal Overload (EoL1) 23: Motor2 Thermal Overload (EoL2) 24: Motor Overheat-PTC (oH3) 26: Over Torque 1 (ot1) 27: Over Torque 2 (ot2) 28: Under current (uc) 31: EEPROM read error (cF2) 33: U phase current sensor detection error (cd1) 34: V phase current sensor detection error (cd2)	35: W phase current sensor detection error (cd3) 36: CC Hardware Logic error 0 (Hd0) 37: OC Hardware Logic error 1 (Hd1) 40: Motor auto tune error (AuE) 41: PID Feedback loss (AFE) 48: Analog input signal loss (ACE) 49: External Fault (EF) 50: Emergency Stop (EF1) 51: Base Block (bb) 52: Password Error (Pcod) 54: PC Command error (CE1) 55: PC Address error (CE2) 56: PC Data error (CE3) 57: PC Slave error (CE4) 58: PC Communication Time Out (CE10) 63: Over Slip Error (oSL) 82: U Phase Loss (UPHL) 83: V Phase Loss (VPHL) 84: W Phase Loss (WPHL) 87: Overload protection at low frequency (oL3) 142: Auto-tune error 1 (AUE1) 143: Auto-tune error 2 (AUE2) 149: Total resistance measurement fault (AUE5) 150: No-load current IO measurement fault (AUE6) 151: dq axis inductance measurement fault (AUE7) 152: High frequency injection measurement fault (AUE8) 157: Pump PID feedback error (dEv)	0611	41554	3021
Note: *Status Monitor 1 corresponds to P06.17 Fault Record 1.*						

GS10 Addresses (continued)					
Description	***Range***		***Modbus Address***		
			Hex	***Dec***	***Octal***
Status monitor read only	High byte: Warning code / Low Byte: Error code		2100	48449	20400
	bit 1–0	AC motor drive operation status 00B: The drive stops 01B: The drive is decelerating 10B: The drive is in standby status 11B: The drive is operating	2101	48450	20401
	bit 2	1: JOG command			
	bit 4–3	Operation direction 00B: FWD running 01B: From REV running to FWD running 10B: From FWD running to REV running 11B: REV running			
	bit 8	1: Master frequency controlled by the communication interface			
	bit 9	1: Master frequency controlled by the analog / external terminal signal			
	bit 10	1: Operation command controlled by the communication interface			
	bit 11	1: Parameter locked			
	bit 12	1: Enable to copy parameters from keypad			
	bit 15–13	Reserved			
	Frequency command (XXX.XX Hz)		2102	48451	20402
	Output frequency (XXX.XX Hz)		2103	48452	20403
	Display the drive’s output current (XX.XX A). When the current is higher than 655.35, it automatically shifts one decimal place as (XXX.X A). Refer to the high byte of 211F for information on the decimal places.		2104	48453	20404
	DC bus voltage (XXX.X V)		2105	48454	20405
	Output voltage (XXX.X V)		2106	48455	20406
	Current step for the multi-step speed operation		2107	48456	20407
	Reserved		2108	48457	20410
	Counter value		2109	48458	20411
	Output power factor angle (XXX.X)		210A	48459	20412
	Output torque (XXX.X %)		210B	48460	20413
	Actual motor speed (XXXXX rpm)		210C	48461	20414

GS10 Addresses (continued)					
Description	***Range***		***Modbus Address***		
			Hex	***Dec***	***Octal***
Command write only	bit 1–0	00B: No function	2000	48193	20000
		01B: Stop			
		10B: Run			
		11B: JOG + RUN			
	bit 3–2	Reserved			
	bit 5–4	00B: No function			
		01B: FWD			
		10B: REV			
		11B: Change direction			
	bit 7–6	00B: 1st accel. / decel.			
		01B: 2nd accel. / decel.			
		10B: 3rd accel. / decel.			
		11B: 4th accel. / decel.			
	bit 11–8	000B: Master speed			
		0001B: 1st step speed frequency			
		0010B: 2nd step speed frequency			
		0011B: 3rd step speed frequency			
		0100B: 4th step speed frequency			
		0101B: 5th step speed frequency			
		0110B: 6th step speed frequency			
		0111B: 7th step speed frequency			
		1000B: 8th step speed frequency			
		1001B: 9th step speed frequency			
		1010B: 10th step speed frequency			
		1011B: 11th step speed frequency			
		1100B: 12th step speed frequency			
		1101B: 13th step speed frequency			
		1110B: 14th step speed frequency			
		1111B: 15th step speed frequency			
	bit 12	1: Enable bit 06–11 function			
	bit 14–13	00B: No function			
		01B: Operated by the digital keypad			
		10B: Operated by Pr.00-21 setting			
		11B: Change the operation source			
	bit 15	Reserved			
	Frequency command (XXX.XX Hz)		2001	48194	20001
	bit 0	1: E.F. (External Fault) ON	2002	48195	20002
	bit 1	1: Reset command			
	bit 2	1: B.B. ON			
	bit 4–3	Reserved			
	bit 5	1: Enable fire mode			
	bit 15–6	Reserved			

See page 4-195 for complete serial address list.

Serial Communications Overview

The *DURAPULSE* GS10 RJ-45 Serial Comm Port will accommodate an RS-485 connection, through which the drive can be controlled by a remote master device on an RS-485 network spanning up to 1200 meters (4000 feet) of cable. RS-232 signals can be converted to RS-485 by using a separate converter.

The *DURAPULSE* GS10 AC drive communication address is specified in P9.00, and the remote master device can control each AC drive according to its individual communication address.

The *DURAPULSE* GS10 AC drive can be configured to communicate using either Modbus RTU or ASCII. The desired protocol is selected in parameter P09.04, COM1 Protocol. (The GS10 drive cannot use both protocols simultaneously.)

- *Standard Modbus protocol using ASCII or RTU transmission modes.*
  Parameter P09.04, Communication Protocol, is used to select the desired mode, number of data bits, parity, and number of stop bits. The mode and serial parameters must be the same for all devices on a Modbus network.

DURApulse GS10 drives have a provision for shutting down control or power to the drive in the event of a communications time out. This feature can be set up through parameters P09.02 (COM1 transmission fault treatment) and P09.03 (COM1 time-out detection).

Serial Communications Connectivity

This section contains information regarding wiring connections to the GS10 RS-485 serial communication ports. For information regarding serial connections to AutomationDirect PLCs, please refer to Appendix D of this user manual, or to the applicable PLC user manual.

Minimum AC Drive Parameter Settings For Serial Communication

The following parameters need to be set as shown in order to communicate properly:

Minimum Parameter Settings (for Communication to ADC PLC)		
Parameter Setting	***Description***	***Setting Value Explanation***
P00.21 = 02	1st Source of Operation Command [Remote]	02: RS-485 communication input
P00.31 = 02	2nd Source of Operation Command [Local]	02: RS-485 communication input, Keypad STOP is Enabled (P00.32)
P02.01~P02.05 = 56	Multifunction Inputs (DI1-DI5) Definition	56: Local/Remote selection
P00.20 = 1	1st Source of Frequency Command [Remote]	1: RS-485 communication input
P00.30 = 1	2nd Source of Frequency Command [Local]	1: RS-485 communication input
P09.00 = 1~254	Communication Address	01~254 Drive Comm Address
P09.01 = 4.8~38.4	Transmission Speed	4.8–38.4 Kbps
P09.04 = 1 to 17	COM1 Protocol	1: 7, N, 2 (ASCII) 2: 7, E, 1 (ASCII) 3: 7, O, 1 (ASCII) 4: 7, E, 2 (ASCII) 5: 7, O, 2 (ASCII) 6: 8, N, 1 (ASCII) 7: 8, N, 2 (ASCII) 8: 8, E, 1 (ASCII) 9: 8, O, 1 (ASCII) 10: 8, E, 2 (ASCII) 11: 8, O, 2 (ASCII) 12: 8, N, 1 (RTU) 13: 8, N, 2 (RTU) 14: 8, E, 1 (RTU) 15: 8, O, 1 (RTU) 16: 8, E, 2 (RTU) 17: 8, O, 2 (RTU)

This list of parameter settings is the minimum required to communicate with an AutomationDirect PLC. There may be other parameters that need to be set to meet the needs of your particular application.

Common Third-Party Modbus RTU Masters

- *KEPSERVER EX 5.0 from www.kepware.com*
- *Modbus Poll from www.modbustools.com*

AutomationDirect PLCs as Modbus Master

Serial Modbus-capable AutomationDirect PLCs can communicate with the GS10 drive.

Serial Modbus control is easier to accomplish from a PLC that has a built-in RS-485 port and supports dedicated Modbus messaging. [RS-232-only PLCs will require an RS-232–RS-485 converter (FA-ISOCON); and older PLCs may require programming to construct the Modbus strings.] We recommend PLCs with built-in RS-485 ports and dedicated Modbus serial commands: CLICK (with RS-485 ports), P1000, P2000, P3000, BRX/Do-more, DirectLogic (DL06, D2-260, or D2-262). Other PLC-Drive connectivity is possible: Please refer to the “Typical ADC PLC to GS10 Serial Connectivity Matrix” below.

Typical ADC PLC to GS10 Serial Communications Connectivity

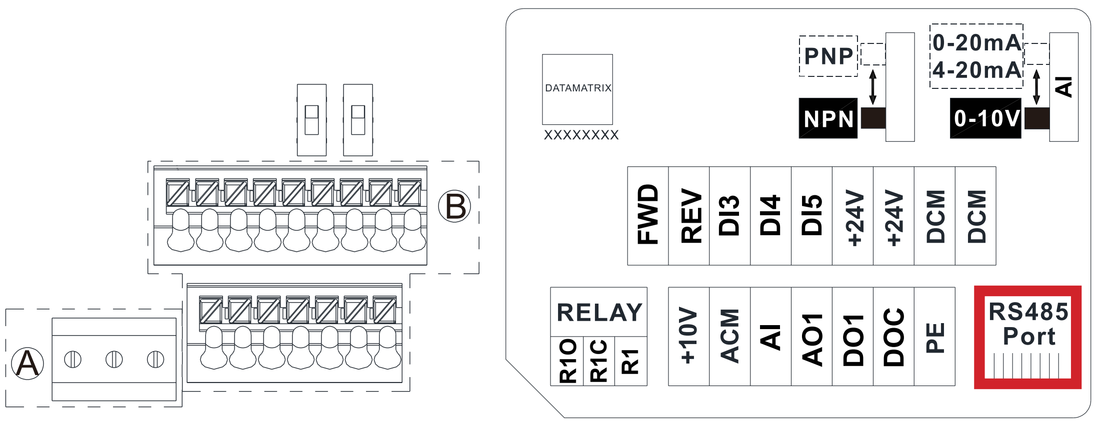
Typical ADC PLC to GS10 Serial Communications Connectivity Matrix						
Recommended PLC Connectivity			***Communication***	***Direct Cable***	***GS10***	
PLC	***Port #***	***Port Type***			***Port Type***	***Port #***
CLICK	3	3 screw terminals	RS-485	Q8304-1 cable	RJ45	n/a
D2-260	2	HD15	RS-485	D2-DSCBL-2		
D2-262	2	HD15	RS-485	D2-DSCBL-2		
DL06	2	HD15	RS-485	D2-DSCBL-2		
BRX/Do-more	RS-485	3 screw terminals	RS-485	Q8304-1 cable		
Do-more H2-DM1	RS-232	RJ12	RS-232 to RS-485	FA-ISOCON with Q8304-1 cable		
P1-550	RS-485	4 screw terminals	RS-485	Q8304-1 cable		
P2-550	RS-485	3 screw terminals	RS-485	Q8304-1 cable		
P3-530	RS-485	3 screw terminals	RS-485	Q8304-1 cable		
P3-550	RS-485	3 screw terminals	RS-485	Q8304-1 cable		
P3-550E	RS-485	3 screw terminals	RS-485	Q8304-1 cable		
Other PLC Connectivity			–	–		
D2-250-1	2	HD15	RS-485	D2-DSCBL-2		
D4-450/D4-454	1	DB25	RS-232 to RS-485	FA-ISOCON with Q8304-1 cable		
DL05	2	RJ12	RS-232 to RS-485	FA-ISOCON with Q8304-1 cable		
DL06 + DCM	2	HD15	RS-485	D2-DSCBL-2		
Do-more H2-DM1 + H2-SERIO-4	3	5 screw terminals	RS-485	Q8304-1 cable		
Do-more T1H-DM1	RS-232	RJ12	RS-232 to RS-485	FA-ISOCON with Q8304-1 cable		
P2-SCM	4	4 screw terminals	RS-485	Q8304-1 cable		
P3-SCM	4	4 screw terminals	RS-485	Q8304-1 cable		

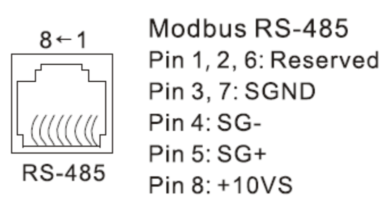
Connecting Communication Cables

A 120 ohm external terminating resistor is required for the drive end. An external termination resistor may be required on the other end of RS-485 network; especially on long runs. Select resistors that match the impedance of the cable (between 100Ω and 500Ω).

The *DURAPULSE* GS10 serial communication port is an RS-485 input. That means the user can use standard RJ45 patch cables or industrial RS-485 cabling to access the comm port. GS10 to GS10 serial connections can be accomplished with standard Ethernet patch cables (do not use cross-over cables). RS-232 signals can be converted to RS-485 by using a separate converter (see the FA-ISOCON drawings on page 5–10).

DURAPULSE GS10 RS-485 Serial Comm Ports





Recommended RS-485 cable: Belden 9842, AutomationDirect L19954 series, or equivalent.

RS-232C to RS-485 Conversion

An RS-485 network cable can span up to 1200 meters (4000 feet). However, many AutomationDirect PLCs have only RS-232C communication ports, and require an FA-ISOCON (RS-232C to RS-422/485 network adapter) in order to make an RS-485 connection.

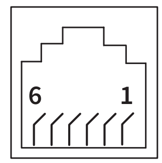
If an FA-ISOCON module is used, set the module dipswitches as required. Refer to the FA-ISOCON manual for more detailed information.

FA-ISOCON Switch Settings:

- *S21–S23: OFF, ON, ON (19200 baud)*
- *S24–S27: OFF (Automatic Network Transmit Enable)*
- *Terminate: ON (end of run term resistors)*
- *Bias (2): ON (end of run bias resistors)*
- *1/2 DPX (2): ON (RS-485 TXD/RXD jumpers)*

Helpful Hint: Some applications require that the FA-ISOCON baud rate is set faster than the drive/network baud rate.

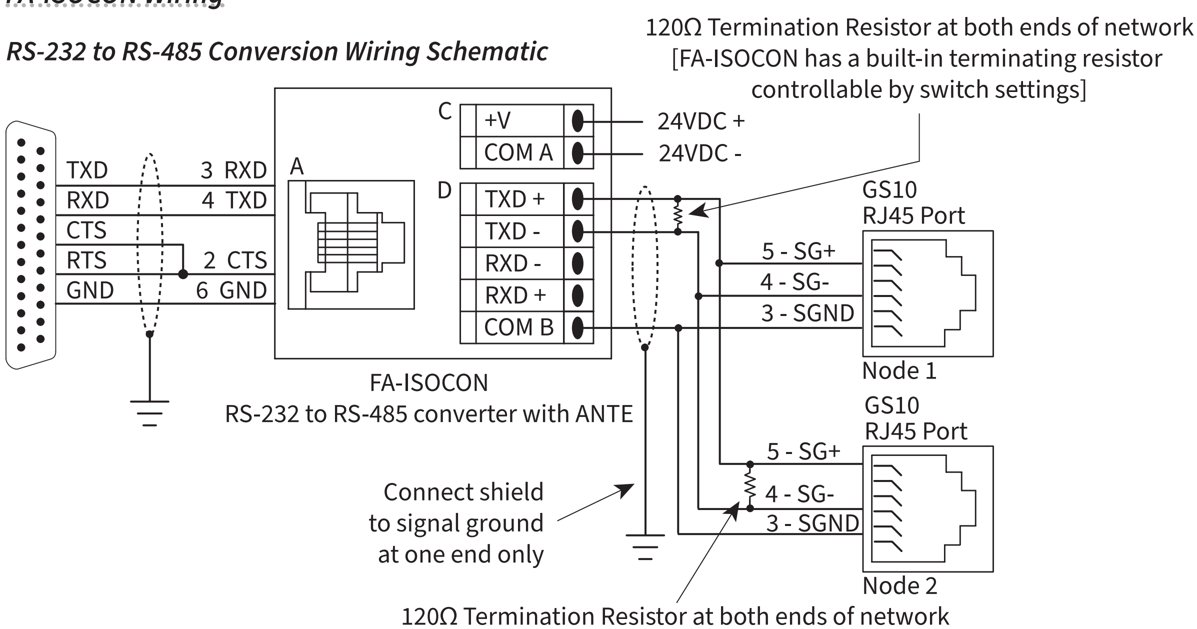
FA-ISOCON RJ-12 Serial Comm Port A
RS-232 Input Port



1: Signal Ground
2: CTS (input)
3: RXD (input)
4: TXD (output)
5: +5VDC in
6: Signal Ground

FA-ISOCON Wiring

RS-232 to RS-485 Conversion Wiring Schematic



For information regarding configuration of AutomationDirect PLCs or other PLCs, please refer to Appendix C of this user manual, or to the applicable PLC user manual for your application.

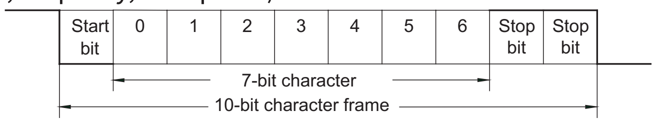
Detailed Serial Modbus Communication Information

The GS10 drive follows the standard Modbus RTU and Modbus ASCII protocols. The following pages provide some brief information on this but if your device does not support these protocols natively and you are required to develop this framework on your own, consult the more detailed documentation at www.modbus.org.

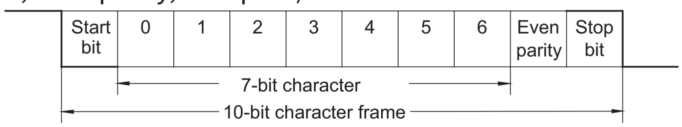
Data Format

ASCII Mode: 10-bit character frame (For 7-bit character):

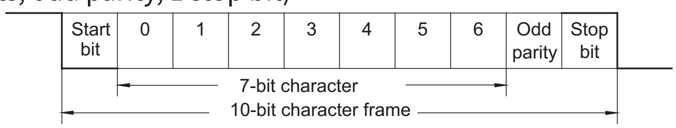
P09.04 = 01 (7 data bits, no parity, 2 stop bits)



P09.04 = 02 (7 data bits, even parity, 1 stop bit)

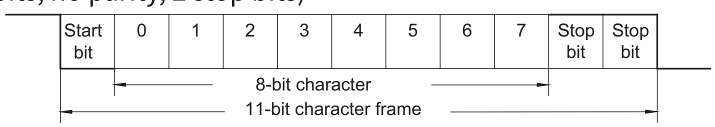


P09.04 = 03 (7 data bits, odd parity, 1 stop bit)

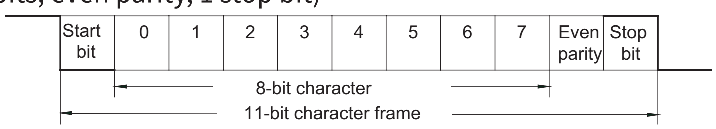


RTU Mode: 11-bit character frame (For 8-bit character):

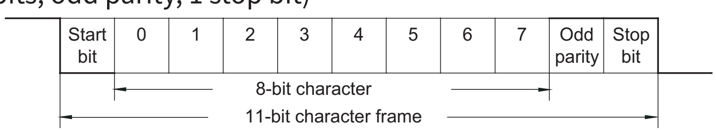
P09.04 = 13 (8 data bits, no parity, 2 stop bits)



P09.04 = 14 (8 data bits, even parity, 1 stop bit)



P09.04 = 15 (8 data bits, odd parity, 1 stop bit)



Communication Protocol

ASCII Mode:

STX	Start Character: (3AH)
ADR 1	Communication Address: 8-bit address consists of 2 ASCII codes
ADR 0	
CMD 1	
CMD 0	
DATA (n-1)	Contents of data: n x 8-bit data consists of 2n ASCII codes. n ≤ 25 maximum of 50 ASCII codes
....	
DATA 0	
LRC CHK 1	LRC check sum: 8-bit check sum consists of 2 ASCII codes
LRC CHK 0	
END 1	END characters: END 1 = CR (0DH); END 0 = LF (0AH)
END 0	

RTU Mode:

START	A silent interval of more than 10 ms
ADR	Communication Address: 8-bit address
CMD	Command Code: 8-bit command
DATA (n-1)	Contents of data: n x 8-bit data, n ≤ 25
....	
DATA 0	
CRC CHK Low	CRC check sum: 16-bit check sum consists of 2 8-bit characters
CRC CHK High	
END	A silent interval of more than 10 ms

ADR (Communication Address)

Valid communication addresses are in the range of 0 to 254. A communication address equal to 0 means broadcast to all AC drives, in which case the drives will not acknowledge any message from the master device.

For example, communication to AC drive with address 16 decimal:

- *ASCII mode: (ADR 1, ADR 0)='1','0' => '1'=31H, '0'=30H*
- *RTU mode: (ADR)=10H*

CMD (Command code) and DATA (data characters)

The format of data characters depends on the command code. The available command codes are described as followed: Command code: 03H, read N words. The maximum value of N is 12. For example, reading continuous 2 words from starting address 2102H of the AC drive with address 01H.

ASCII mode:

Command Message		***Response Message***	
STX	':'	STX ':'	':'
ADR 1	'0'	ADR 1	'0'
ADR 0	'1'	ADR 0	'1'
CMD 1	'0'	CMD 1	'0'
CMD 0	'3'	CMD 0	'3'
Starting data address	'2'	Number of data (Count by byte)	'0'
	'1'		'4'
	'0'	Content of starting data address 2102H	'1'
	'2'		'7'
Number of data (Count by word)	'0'		'7'
	'0'		'0'
	'0'	Content data address 2103H	'0'
	'2'		'0'
LRC CHK 1	'D'		'0'
LRC CHK 0	'7'		'0'
END 1	CR	LRC CHK 1	'7'
END 0	LF	LRC CHK 0	'1'
		END 1	CR
		END 0	LF

RTU mode:

Command Message		***Response Message***	
ADR	01H	ADR	01H
CMD	03H	CMD	03H
Starting data address	21H	Number of data (Count by byte)	04H
	02H		'0'
Number of data (Count by word)	00H	Content of data address 2102H	17H
	02H		70H
CRC CHK Low	6FH	Content of data address 2103H	00H
CRC CHK High	F7H		02H
		CRC CHK Low	FEH
		CRC CHK High	5CH

Command code: 06H, write 1 word

For example, writing 6000(1770H) to address 0100H of the AC drive with address 01H.

ASCII mode:

Command Message			***Response Message***	
STX	':'		STX ':'	':'
ADR 1	'0'		ADR 1	'0'
ADR 0	'1'		ADR 0	'1'
CMD 1	'0'		CMD 1	'0'
CMD 0	'6'		CMD 0	'6'
Data Address	'0'		Data Address	'0'
	'1'			'1'
	'0'			'0'
	'0'			'0'
	'1'		Data Content	'1'
	'7'			'7'
	'7'			'7'
	'0'			'0'
LRC CHK 1	'7'		LRC CHK 1	'7'
LRC CHK 0	'1'		LRC CHK 0	'1'
END 1	CR		END 1	CR
END 0	LF		END 0	LF

RTU mode:

This is an example of using function code 16 for writing to multiple registers.

Command Message			***Response Message***	
ADR	01H		ADR	01H
CMD	10H		CMD	10H
Starting data address	20H		Starting data address	20H
	00H			00H
Number of registers	00H		Number of data (Count by word)	00H
	02H			02H
Byte count	04H		CRC CHK Low	4AH
Content of data address 2000H	00H		CRC CHK High	08H
	02H			
Content of data address 2001H	02H			
	58H			
CRC CHK Low	CBH			
CRC CHK High	34H			

NOTE Concerning 2100h: When GS10 drive is setup with reference RS-485 (P00.20 = 1 and drive in Remote/Auto) -OR- (P00.30 = 1 and drive in Local/Hand) -AND- Reference > P01.00 Drive Max Out Freq, the GS10 drive goes up to Max Out Freq and remains there until Max Out Freq is modified or a lower Freq Ref or a Stop Command is sent to the drive.

CHK (check sum)

ASCII Mode:

LRC (Longitudinal Redundancy Check) is calculated by summing up module 256, the values of the bytes from ADR1 to last data character, then calculating the hexadecimal representation of the 2's-complement negation of the sum.

For example, reading 1 word from address 0401h of the AC drive with address 01h.

Command Message	
STX	':'
ADR 1	'0'
ADR 0	'1'
CMD 1	'0'
CMD 0	'3'
Starting data address	'0'
	'4'
	'0'
	'1'
Number of data (Count by word)	'0'
	'0'
	'0'
	'1'
LRC CHK 1	'F'
LRC CHK 0	'6'
END 1	CR
END 0	LF

01h+03h+04h+01h+00h+01h=0Ah;
the 2's complement negation of 0Ah is F6h.

RTU Mode:

Response Message	
ADR	01h
CMD	03h
Starting data address	21h
	02h
Number of data (Count by word)	00h
	02h
CRC CHK Low	6Fh
CRC CHK High	F7h

CRC (Cyclical Redundancy Check) is calculated by the following steps:

10) Load a 16-bit register (called CRC register) with FFFFh.
11) Exclusive OR the first 8-bit byte of the command message with the low order byte of the 16-bit CRC register, putting the result in the CRC register.
12) Shift the CRC register one bit to the right with MSB zero filling. Extract and examine the LSB.
13) If the LSB of CRC register is 0, repeat step 3; else Exclusive or the CRC register with the polynomial value A001h.
14) Repeat step 3 and 4 until eight shifts have been performed. When this is done, a complete 8-bit byte will have been processed.
15) Repeat steps 2 to 5 for the next 8-bit byte of the command message.

Continue doing this until all bytes have been processed. The final contents of the CRC register are the CRC value.

When transmitting the CRC value in the message, the upper and lower bytes of the CRC value must be swapped, i.e. the lower order byte will be transmitted first.

The following is an example of CRC generation using C language. The function takes two arguments:

```
Unsigned char* data ← a pointer to the message buffer
Unsigned char length ← the quantity of bytes in the message buffer
    The function returns the CRC value as a type of unsigned integer.
        Unsigned int crc_chk(unsigned char* data, unsigned char length){
            int j;
            unsigned int reg_crc=0xFFFF;
            while(length--){
                        reg_crc ^= *data++;
                        for(j=0;j<8;j++){
                            if(reg_crc & 0x01){  /* LSB(b0)=1 */
                                reg_crc=(reg_crc>>1) ^ 0xA001;
                        }else{
                                reg_crc=reg_crc >>1;
                        }
                    }
                }
            return reg_crc;
        }
```

RTU mode is preferred. Limited support is available to ASCII users.

Maintenance and Troubleshooting

Chapter 6

Table of Contents

Maintenance and Inspections

Modern AC drives are based on solid state electronics technology, including ICs, resistors, capacitors, transistors, cooling fans, relays, etc. These components have a limited life under normal operation. Preventive maintenance is required to operate the GS10 drive in its optimal condition, and to ensure a long life. We recommend that a qualified technician perform a regular inspection of the GS10 drive. Some items should be checked once a month, and some items should be checked yearly.

CAUTION: All inspections should be accomplished with Safety in mind with due and required caution. Some of these Inspection items may require the Drive to be powered down, while others may require power to be applied. Proper safety precautions including the use of PPE are/may be required. Please review cautionary statements in each section

Monthly Inspection

Check the following items at least once a month.

1) *Make sure the motors are operating as expected.*
2) *Make sure the drive installation environment is normal.*
3) *Make sure the enclosure and drive cooling systems are operating as expected.*
4) *Check for irregular vibrations or sounds during operation.*
5) *Make sure the motors are not overheating during operation.*
6) *Check the input voltage to the* GS10 *drive and make sure the voltage is within the operating range. Check the voltage with a voltmeter.*

Annual Inspection

Check the following items once annually.

1) *Check the torque of the GS10 power and control terminal screws and tighten if necessary. They may loosen due to vibration or changing temperatures.*
2) *Make sure the conductors and insulators are not corroded or damaged.*
3) *Check the resistance of cable insulation with a megohmmeter.*
4) *Clean off any dust and dirt with a vacuum cleaner. Pay special attention to cleaning the ventilation ports and PCBs. Always keep these areas clean. Accumulation of dust and dirt in these areas can cause unforeseen failures.*
5) *Recharge the capacitors of any drive that is in storage or is otherwise unused.*

Recharge Capacitors (for drives not in service)

Recharge the DC link before using any drive that has not been operated within a year:

1) *Disconnect the motor from the drive.*
2) *Apply input power to the drive for 2 hours.*

If the drive is stored or is otherwise unused for more than a year, the drive's internal DC link capacitors should be recharged before use. Otherwise, the capacitors may be damaged when the drive starts to operate. We recommend recharging the capacitors of any unused drive at least once per year.

Disconnect AC power and ensure that the internal capacitors have fully discharged before inspecting the GS10 drive! Wait at least FIVE minutes after all display lamps have turned off.

CAUTION

☑	Wait 5 seconds after a fault has been cleared before performing reset via keypad or input terminal.
☑	When the power is off after 5 minutes for ≤ 30hp models and 10 minutes for ≥ 40hp models, please confirm that the capacitors have fully discharged by measuring the voltage between + and -. The voltage between + and - should be less than 25VDC.
☑	Only qualified personnel can install, wire and maintain drives. Please take off any metal objects, such as watches and rings, before operation. And only insulated tools are allowed.
☑	Never reassemble internal components or wiring.
☑	Make sure that installation environment complies with regulations without abnormal noise, vibration and smell.

Recommended Inspection Schedules

Before the check-up, always turn off the AC input power and remove the cover. Wait at least 10 minutes after all display lamps have gone out, and then confirm that the capacitors have fully discharged by measuring the voltage between DC+ and DC-. The voltage between DC+ and DC-should be less than 25VDC.

Ambient environment

Check Items	Methods and Criteria	Maintenance Period		
		Daily	Half Year	One Year
Check the ambient temperature, humidity, vibration and see if there is any dust, gas, oil or water drops	Visual inspection and measurement with equipment against standard specifications	○		
If there are any dangerous objects	Visual inspection	○		

Voltage

Check Items	Methods and Criteria	Maintenance Period		
		Daily	Half Year	One Year
Check if the voltage of main circuit and control circuit is correct	Measure with multimeter against standard specifications	○		

Digital Keypad Display

Check Items	Methods and Criteria	Maintenance Period		
		Daily	Half Year	One Year
Is the display clear for reading	Visual inspection	○		
Any missing characters	Visual inspection	○		

Mechanical parts

Check Items	Methods and Criteria	Maintenance Period		
		Daily	Half Year	One Year
If there is any abnormal sound or vibration	Visual and audible inspection		○	
If there are any loose screws	Tighten the screws		○	
If any part is deformed or damaged	Visual inspection		○	
If there is any color change due to overheating	Visual inspection		○	
If there is any dust or dirt	Visual inspection		○	

Recommended Inspection Schedules (continued)

Main circuit

Check Items	Methods and Criteria	Maintenance Period		
		Daily	Half Year	One Year
If there are any loose or missing screws	Tighten or replace the screw	○		
If any drive or wiring insulation is deformed, cracked, damaged or has changed color due to overheating or aging	Visual inspection **NOTE: Ignore any color change of copper plate**		○	
If there is any dust or dirt	Visual inspection		○	

Terminals and wiring of main circuit

Check Items	Methods and Criteria	Maintenance Period		
		Daily	Half Year	One Year
If the terminal color or the placement has changed due to overheating	Visual inspection		○	
If the wiring insulation is damaged or there has been a color change	Visual inspection		○	
If there is any damage	Visual inspection	○		

DC capacity of main circuit

Check Items	Methods and Criteria	Maintenance Period		
		Daily	Half Year	One Year
If there is any liquid leaking, color change, crack or deformation	Visual inspection	○		
If the capacitor safety vent is bulging or inflated.	Visual inspection	○		
Measure static capacity when required (if drive overloads/faults during normal operation)	Measure with multimeter against standard specifications	○		

Recommended Inspection Schedules (continued)

Resistor of main circuit

Check Items	Methods and Criteria	Maintenance Period		
		Daily	Half Year	One Year
If there is any peculiar smell or insulation cracks due to overheating	Visual inspection, smell	○		
If there is any disconnection or discoloration	Visual inspection	○		
If the connection is damaged	Measure with a multimeter against standard specifications	○		

Transformer and reactor of main circuit

Check Items	Methods and Criteria	Maintenance Period		
		Daily	Half Year	One Year
If there is any abnormal vibration or peculiar smell	Visual, audible inspection and smell	○		

Magnetic contactor and relay of main circuit

Check Items	Methods and Criteria	Maintenance Period		
		Daily	Half Year	One Year
If there are any loose screws	Visual and audible inspection	○		
If the contact works correctly	Visual inspection	○		

Printed circuit board and connector of main circuit

Check Items	Methods and Criteria	Maintenance Period		
		Daily	Half Year	One Year
If there are any loose screws and connectors	Tighten the screws and press the connectors firmly in place		○	
If there is any peculiar smell and/or color change	Visual and smell inspection		○	
If there is any crack, damage, deformation or corrosion	Visual inspection		○	
If there is any liquid leakage or deformation in capacity	Visual inspection		○	

Recommended Inspection Schedules (continued)

Cooling fan of cooling system

Check Items	Methods and Criteria	Maintenance Period		
		Daily	Half Year	One Year
If there is any abnormal sound or vibration	Visual, audible inspection and turn the fan with hand (turn off the power before operation) to see if it rotates smoothly		○	
If there is any loose screw	Tighten the screw		○	
If there is any color change due to overheating	Change the fan		○	

Ventilation channel of cooling system

Check Items	Methods and Criteria	Maintenance Period		
		Daily	Half Year	One Year
If there is any obstruction in the heat sink, air intake or air outlet	Visual inspection		○	

Please use a clean lint free cloth for cleaning and use a dust cleaner to remove dust when necessary.

Troubleshooting

Warning Codes

The GS10 drive has a comprehensive diagnostic system that includes several different warning codes. The most common warning codes can be read on the digital keypad display.

For communication errors, “Upper unit” is referring to the Master controller of the serial network. Always ensure the communication settings of the drive (P09.01 and P09.04) match those of the master controller and network.

Warning Codes

Display on GS10 Keypad	ID No.	Warning Name and Description	Action and Reset		Corrective Action
n/a	0	No error	n/a	n/a	n/a
CE3	3	Communication error 3 (CE3) RS-485 Modbus illegal data value	Action Level	When the length of communication data is too long	1) Check if the communication command is correct. 2) Verify the wiring and grounding of the communication circuit. Separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance. 3) Check if the setting for P09.04 is the same as the setting for the upper unit. 4) Check the cable and replace it if necessary.
			Action Time	Immediately act	
			Warning setting parameter	N/A	
			Reset method	“Warning” occurs when P09.02=0 and the motor drive keeps running. The drive resets automatically when receiving the correct communication data value.	
			Reset condition	Immediately reset	
			Record	N/A	
CE4	4	Communication error 4 (CE4) RS-485 Modbus data is written to read-only address	Action Level	When the data is written to read-only address	1) Check if the communication command is correct 2) Verify the wiring and grounding of the communication circuit. Separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance. 3) Check if the setting for P09.04 is the same as the setting for the upper unit. 4) Check the cable and replace it if necessary.
			Action Time	Immediately act	
			Warning setting parameter	N/A	
			Reset method	“Warning” occurs when P09.02=0 and the motor drive keeps running. The drive resets automatically when receiving the correct written address of communication data.	
			Reset condition	Immediately reset	
			Record	N/A	
CE10	5	Communication error 10 (CE10) RS-485 Modbus transmission time-out	Action Level	When the communication time exceeds the detection time of P09.03 communication time-out	1) Check if the upper unit transmits the communication command within the setting time for P09.03. 2) Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance. 3) Check if the setting for P09.04 is the same as the setting for the upper unit. 4) Check the cable and replace it if necessary.
			Action Time	P09.03	
			Warning setting parameter	N/A	
			Reset method	“Warning” occurs when P09.02=0 and the motor drive keeps running. The drive resets automatically when receiving the next communication packet.	
			Reset condition	Immediately reset	
			Record	N/A	

(continued next page)

<table>
<tr><th colspan="6">Warning Codes (continued)</th></tr>
<tr><th>Display on GS10 Keypad</th><th>ID No.</th><th>Warning Name and Description</th><th colspan="2">Action and Reset</th><th>Corrective Action</th></tr>
<tr><td rowspan="6">SE1</td><td rowspan="6">7</td><td rowspan="6">Save error 1 (SE1)

Keypad COPY error 1: Keypad copy time-out</td><td>Action Level</td><td>“SE1” warning occurs when the GS4-KPD optional keypad does not transmit the COPY command to the drive, and does not transmit any data to the drive again in 10 ms at the time you copy the parameters to the drive.</td><td rowspan="6">SE1: The causes of error are mostly communication problems between the keypad and control board. Potential causes include communication signal interference and the unacceptable communication command to the Slave. Check if the error occurs randomly, or only occurs when copying certain parameters (the error displays on the upper right corner of the copy page). If you cannot clear the error, please contact AutomationDirect Technical Support.</td></tr>
<tr><td>Action Time</td><td>10 ms</td></tr>
<tr><td>Warning setting parameter</td><td>N/A</td></tr>
<tr><td>Reset method</td><td>Manual reset (or cycle power)</td></tr>
<tr><td>Reset condition</td><td>Immediately reset</td></tr>
<tr><td>Record</td><td>N/A</td></tr>
<tr><td rowspan="6">SE2</td><td rowspan="6">8</td><td rowspan="6">Save error 2 (SE2)

Keypad COPY error 2: parameter writing error</td><td>Action Level</td><td>“SE2” warning occurs when writing the parameters incorrectly at the time you copy parameters to the drive. For example, you copy the new firmware version with added parameters to the drive with old firmware version.</td><td rowspan="6">SE2: In this stage, the copied data has been transmitted to the Slave.
The Slave compares and processes the copied data, and then saves the data to the Data ROM. During the process, the data error (should be attribution error) may occur, or the data cannot be saved to EEPROM. At this time, the warning occurs.
Check the status of Data ROM and remove the error causes first.
If you cannot clear the error, please contact AutomationDirect Technical Support.</td></tr>
<tr><td>Action Time</td><td>N/A</td></tr>
<tr><td>Warning setting parameter</td><td>N/A</td></tr>
<tr><td>Reset method</td><td>Manual reset (or cycle power)</td></tr>
<tr><td>Reset condition</td><td>Immediately reset</td></tr>
<tr><td>Record</td><td>N/A</td></tr>
<tr><td rowspan="6">oH1</td><td rowspan="6">9</td><td rowspan="6">IGBT over-heating warning (oH1)

The AC motor drive detects IGBT overheating and exceeds the protection level of oH1 warning. (When P06.15 is higher than the IGBT overheating protection level, the drive shows oH1 error without displaying oH1 warning.)</td><td>Action Level</td><td>P06.15</td><td rowspan="6">1) Check the ambient temperature.
2) Regularly inspect the ventilation hole of the control cabinet.
3) Change the installed location if there are heating objects, such as braking resistors, in the surroundings.
4) Install/add cooling fan or air conditioner to lower the temperature inside the cabinet.
5) Check for and remove obstructions or replace the cooling fan.
6) Increase ventilation space of the drive.
7) Decrease loading.
8) Decrease the carrier wave.
9) Replace the drive with higher capacity model.</td></tr>
<tr><td>Action Time</td><td>“oH1” warning occurs when IGBT temperature is higher than P06.15 setting value.</td></tr>
<tr><td>Warning setting parameter</td><td>N/A</td></tr>
<tr><td>Reset method</td><td>Auto-reset</td></tr>
<tr><td>Reset condition</td><td>The drive auto-resets when IGBT temperature is lower than oH1 warning level minus (–) 5°C</td></tr>
<tr><td>Record</td><td>N/A</td></tr>
<tr><td colspan="6">(continued next page)</td></tr>
</table>

Warning Codes (continued)

Display on GS10 Keypad	ID No.	Warning Name and Description	Action and Reset		Corrective Action
PId	11	PID feedback error (PID) PID feedback loss (warning for analog feedback signal; works only when PID enables)	Action Level	When the analog input is lower than 4 mA (only detects analog input 4–20 mA)	1) Check the PID feedback wiring and tighten the terminals. 2) Replace the cable. 3) Replace the feedback device. 4) If the PID error still occurs after checking all the wiring, contact AutomationDirect Technical Support.
			Action Time	P08.08	
			Warning setting parameter	P08.09 setting is: 0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: Warn and operate at last frequency	
			Reset method	1) Auto: “Warning” occurs when P08.09=0 or 3. The “Warning” automatically clears when the feedback signal is larger than 4 mA. 2) Manual: “Error” occurs when P08.09=1 or 2. You must reset manually.	
			Reset condition	Immediately reset	
			Record	Records when P08.09=1 or 2 (“Error”). Does not record when P08.09=3 (“Warning”).	
AnL	12	AI-C analog signal loss (AnL) Analog input current loss (including all analog 4–20 mA signals)	Action Level	When the analog input is lower than 4 mA (only detects analog input 4–20 mA)	1) Check the AI wiring and tighten the terminals. 2) Replace the cable. 3) Replace the external device. 4) If the AnL error still occurs after checking all the wiring, contact AutomationDirect Technical Support.
			Action Time	Immediately act	
			Warning setting parameter	P03.19 setting is: 0: Disable 1: Continue operation at the last frequency (warning, keypad displays ANL) 2: Decelerate to 0 Hz (warning, keypad displays ANL) 3: Stop immediately and display “ACE”	
			Reset method	1) Auto: “Warning” occurs when P03.19=1 or 2. The “Warning” automatically clears when the feedback signal is larger than 4 mA. 2) Manual: “Error” occurs when P03.19=3. You must reset manually.	
			Reset condition	Immediately reset	
			Record	Does not record when P03.19=1 or 2 (“Warning”).	

(continued next page)

<table>
<tr><th colspan="6">Warning Codes (continued)</th></tr>
<tr><th>Display on GS10 Keypad</th><th>ID No.</th><th>Warning Name and Description</th><th colspan="2">Action and Reset</th><th>Corrective Action</th></tr>
<tr><td rowspan="6">UC</td><td rowspan="6">13</td><td rowspan="6">Under current (uC)

Low current</td><td>Action Level</td><td>P06.71</td><td rowspan="6">1) Check for a broken motor cable, then exclude the connection issue of the motor and its load.
2) Verify low current protection settings. If needed, set the proper settings for P06.71, P06.72 and P06.73.
3) Check the loading status and make sure the loading matches the motor capacity.</td></tr>
<tr><td>Action Time</td><td>P06.72</td></tr>
<tr><td>Warning setting parameter</td><td>P06.73 setting is:
0: No function
1: Fault and coast to stop
2: Fault and ramp to stop by the 2nd deceleration time
3: Warn and continue operation</td></tr>
<tr><td>Reset method</td><td>1) Auto: “Warning” occurs when P06.73=3. The “Warning” automatically clears when the output current is larger than (P06.71+0.1 A).
2) Manual: “Error” occurs when P06.73=1 or 2. You must reset manually.</td></tr>
<tr><td>Reset condition</td><td>Immediately reset</td></tr>
<tr><td>Record</td><td>Does not record when P06.73=3 and uC displays (“Warning”).</td></tr>
<tr><td rowspan="6">ot 1</td><td rowspan="6">20</td><td rowspan="6">Over-torque 1 (ot1)

Over-torque 1 warning</td><td>Action Level</td><td>P06.07</td><td rowspan="6">1) Configure the settings for P06.07 and P06.08 again.
2) Check for mechanical error and remove the causes of malfunction.
3) Verify load and decrease the loading or replace with a motor with larger capacity if load is too high.
4) Verify accel/decel time and increase the setting values for P01.12–P01.19 (accel./ decel. time) if work cycle is too short.
5) Verify V/F voltage and adjust the V/F curve (Motor 1, P01.01–P01.08), especially the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low-speed).
6) Replace motor with a larger capacity motor.
7) Check for overload during low-speed operation and decrease the loading during low-speed operation or increase the motor capacity.
8) Verify torque compensation and adjust P07.26 torque compensation gain until the output current decreases and the motor does not stall.
9) Correct the parameter settings for speed tracking. Start the speed tracking function. Adjust the maximum current for P07.09 speed tracking.</td></tr>
<tr><td>Action Time</td><td>P06.08</td></tr>
<tr><td>Warning setting parameter</td><td>P06.06 Over-torque Detection Selection (Motor 1) =1 or 3
0: No function
1: Continue operation after over-torque detection during constant speed operation
2: Stop after over-torque detection during constant speed operation
3: Continue operation after over-torque detection during RUN
4: Stop after over-torque detection during RUN</td></tr>
<tr><td>Reset method</td><td>When the output current < P06.07, the ot1 warning automatically clears</td></tr>
<tr><td>Reset condition</td><td>When the output current < P06.07, the ot1 warning automatically clears</td></tr>
<tr><td>Record</td><td>N/A</td></tr>
<tr><td colspan="6">(continued next page)</td></tr>
</table>

Warning Codes (continued)

Display on GS10 Keypad	ID No.	Warning Name and Description	Action and Reset		Corrective Action
ot2	21	Over-torque (ot2) Over-torque 2 warning	Action Level	P06.10	1) Configure the settings for P06.10 and P06.11 again. 2) Check for mechanical error and remove the causes of malfunction. 3) Verify load and decrease the loading or replace with a motor with larger capacity if load is too high. 4) Verify accel/decel time and increase the setting values for P01.12–P01.19 (accel./ decel. time) if work cycle is too short. 5) Verify V/F voltage and adjust the V/F curve (Motor 2, P01.35–P01.42), especially the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low-speed). 6) Replace motor with a larger capacity motor. 7) Check for overload during low-speed operation and decrease the loading during low-speed operation or increase the motor capacity. 8) Verify torque compensation and adjust P07.71 torque compensation gain until the output current decreases and the motor does not stall. 9) Correct the parameter settings for speed tracking. Start the speed tracking function. Adjust the maximum current for P07.09 speed tracking.
			Action Time	P06.11	
			Warning setting parameter	P06.09 Over-torque Detection Selection (Motor 2) =1 or 3 0: No function 1: Continue operation after over-torque detection during constant speed operation 2: Stop after over-torque detection during constant speed operation 3: Continue operation after over-torque detection during RUN 4: Stop after over-torque detection during RUN	
			Reset method	When the output current < P06.10, the ot2 warning automatically clears	
			Reset condition	When the output current < P06.10, the ot2 warning automatically clears	
			Record	N/A	

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Warning Codes (continued)					
Display on GS10 Keypad	***ID No.***	***Warning Name and Description***	***Action and Reset***		***Corrective Action***
oH3	22_1	Motor over-heating (oH3) PTC Motor overheating warning. The AC motor drive detects the temperature inside the motor is too high	Action Level	P03.00=6 (PTC), PTC input level > P06.30 PTC level (default=50%)	1) Check if motor is locked and clear the motor lock status. 2) Verify load and decrease the loading or replace with a motor with larger capacity if load is too high. 3) Verify ambient temperature and change the installed location if there are heating devices in the surroundings, or install/add cooling fan or air conditioner to lower the ambient temperature. 4) Check the cooling system and ensure it's working normally. 5) Verify the motor fan is working and replace the fan if needed. 6) Verify duration of low speed operation. Decrease low-speed operation time. Change to dedicated motor for the drive. Increase the motor capacity. 7) Verify accel/decel time and increase setting values for P01.12–P01.19 (accel./ decel. time) if working cycle is too short. 8) Verify V/F voltage and adjust settings for P01.01–P01.08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low-speed). 9) Verify the motor rated current matches the motor nameplate and configure the correct rated current value of the motor if needed. 10) Check the connection between PTC thermistor and the heat protection. 11) Verify stall prevention setting and set the stall prevention to the proper value if needed. 12) Check for unbalanced three-phase motor impedance. Replace the motor if needed. 13) Verify harmonics and reduce harmonics if too high.
			Action Time	Immediately act	
			Warning setting parameter	Error treatment: P06.29 0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning When P06.29=0 and when the temperature is ≤ P06.30 level, the oH3 warning automatically clears. When P06.29=0 ("Warning"), it automatically resets.	
			Reset method	When P06.29=0, oH3 displays as "Warning". When the temperature is ≤ P06.30 level, the oH3 warning automatically clears.	
			Reset condition	When the temperature is ≤ P06.30 level, the oH3 warning automatically clears.	
			Record	N/A	
(continued next page)					

Warning Codes (continued)					
Display on GS10 Keypad	***ID No.***	***Warning Name and Description***	***Action and Reset***		***Corrective Action***
oH3	22_2	Motor over-heating (oH3) PT100 RTD Motor overheating warning. The AC motor drive detects the temperature inside the motor is too high	Action Level	P03.00=11 (PT100), PT100 RTD input level > P06.57 (default=7V)	1) Check if motor is locked and clear the motor lock status. 2) Verify load and decrease the loading or replace with a motor with larger capacity if load is too high. 3) Verify ambient temperature and change the installed location if there are heating devices in the surroundings, or install/add cooling fan or air conditioner to lower the ambient temperature. 4) Check the cooling system and ensure it's working normally. 5) Verify the motor fan is working and replace the fan if needed. 6) Verify duration of low speed operation. Decrease low-speed operation time. Change to dedicated motor for the drive. Increase the motor capacity. 7) Verify accel/decel time and increase setting values for P01.12–P01.19 (accel./ decel. time) if working cycle is too short. 8) Verify V/F voltage and adjust settings for P01.01–P01.08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low-speed). 9) Verify the motor rated current matches the motor nameplate and configure the correct rated current value of the motor if needed. 10) Check the connection between PT100 RTD and the heat protection. 11) Verify stall prevention setting and set the stall prevention to the proper value if needed. 12) Check for unbalanced three-phase motor impedance. Replace the motor if needed. 13) Verify harmonics and reduce harmonics if too high.
			Action Time	Immediately act	
			Warning setting parameter	Error treatment: P06.29 0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning When P06.29=0 and when the temperature is ≤ P06.56 level, the oH3 warning automatically clears. If the temperature is between P06.56 and P06.57, the frequency outputs according to the operating frequency setting for P06.58.	
			Reset method	When P06.29=0, oH3 displays as "Warning". When the temperature is ≤ P06.56 level, the oH3 warning automatically clears.	
			Reset condition	When the temperature is ≤ P06.56 level, the oH3 warning automatically clears.	
			Record	N/A	
oSL	24	Over slip warning (oSL) Over slip warning. By using the maximum slip (P10.29) as the base, when the drive outputs at constant speed, and the F>H or F<H exceeds P07.29 level and P.07.30 setting time, 100% P07.29 = P10.29.	Action Level	When the drive outputs at constant speed, and F>H or F<H exceeds the P07.29 level	1) Check the motor parameter. 2) Verify load and decrease the loading if needed. 3) Verify the parameter settings for oSL protection (P07.29, P07.30, and P10.29) are correctly set.
			Action Time	P07.30	
			Warning setting parameter	P07.31=0 Warning 0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning	
			Reset method	When P07.31=0 and when the drive outputs at constant speed, and F>H or F<H no longer exceeds the P07.29 level, the oSL warning automatically clears.	
			Reset condition	N/A	
			Record	N/A	

(continued next page)

Warning Codes (continued)					
Display on GS10 Keypad	**ID No.**	**Warning Name and Description**	**Action and Reset**		**Corrective Action**
tUn	25	Auto tuning (tUn) Parameter auto-tuning is processing. When running auto-tuning, the keypad displays “tUn”.	Action Level	When running P05.00 motor parameter auto-tuning, the keypad displays “tUn”.	When the auto-tuning is finished, the warning automatically clears.
			Action Time	N/A	
			Warning setting parameter	N/A	
			Reset method	When auto-tuning is finished and no error occurs, the warning automatically clears.	
			Reset condition	When auto-tuning is finished and no error occurs.	
			Record	N/A	
oPHL	28	Output phase loss (oPHL) Output phase loss of the drive	Action Level	P06.47	1) Check for unbalanced three-phase motor impedance and replace the motor if needed. 2) Check the cable and replace if needed. 3) Ensure a three-phase motor is being used. 4) Check if the control board cable is loose. If yes, reconnect the cable and run the drive to test. If the error still occurs, contact AutomationDirect Technical Support. 5) Check if the three-phase current is balanced with a current clamp meter. If the current is balanced and the oPHL error still shows on the display, contact AutomationDirect Technical Support. 6) Verify the drive’s capacity matches or exceeds the motor’s.
			Action Time	N/A	
			Warning setting parameter	P06.45 setting is: 0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning	
			Reset method	If P06.45 is set to 0, the oPHL warning automatically clears after the drive stops.	
			Reset condition	N/A	
			Record	N/A	
SE3	30	Copy model error 3 (SE3) Keypad COPY error 3: copy model error	Action Level	“SE3” warning occurs when different drive identity codes are found during copying parameters.	It is mainly to prevent parameter copies between different HP/models.
			Action Time	Immediately act when the error is detected	
			Warning setting parameter	N/A	
			Reset method	Manual reset	
			Reset condition	N/A	
			Record	N/A	
(continued next page)					

<table>
<tr><th colspan="6">Warning Codes (continued)</th></tr>
<tr><th>Display on GS10 Keypad</th><th>ID No.</th><th>Warning Name and Description</th><th colspan="2">Action and Reset</th><th>Corrective Action</th></tr>
<tr><td rowspan="6">dEb</td><td rowspan="6">102</td><td rowspan="6">Deceleration energy backup error (dEb)

When P07.13 is not 0 and the power shuts off resulting in DC bus voltage lower than the dEb action level, the dEb function acts and the motor ramps to stop. dEb displays on the keypad.</td><td>Action Level</td><td>When P07.13 is not 0 and the DC bus voltage is lower than the level of dEb.</td><td rowspan="6">Check the power system.
1) Replace power system with a larger capacity system.
2) Use a different power system from the large load system.</td></tr>
<tr><td>Action Time</td><td>Immediately act</td></tr>
<tr><td>Warning setting parameter</td><td>N/A</td></tr>
<tr><td>Reset method</td><td>Auto: when P07.13=2 (dEb with auto-acceleration/auto-deceleration, drive outputs frequency after power is restored), dEb is automatically cleared.
Manual: When P07.13=1 (dEb with auto-acceleration/auto-deceleration, drive does not output frequency after power is restored), the drive stops when dEb acts. When the rotation speed is 0Hz the drive can be manually reset.</td></tr>
<tr><td>Reset condition</td><td>Auto: the fault is automatically cleared.
Manual: When the drive decelerates to 0Hz</td></tr>
<tr><td>Record</td><td>Yes</td></tr>
<tr><td rowspan="6">dEu</td><td rowspan="6">103</td><td rowspan="6">PID feedback fault (dEv)

PID feedback fault.</td><td>Action Level</td><td>Verify if the value of the feedback deviation is lower than the setting at P08.13.</td><td rowspan="6">1) Check for PID feedback pressure loss or feedback error.
2) Check for pressure sensor fault or feedback error.
3) Check for insufficient pressure or feedback error.</td></tr>
<tr><td>Action Time</td><td>P08.14</td></tr>
<tr><td>Warning setting parameter</td><td>P08.62</td></tr>
<tr><td>Reset method</td><td>Manual reset</td></tr>
<tr><td>Reset condition</td><td>When the feedback value is back to the setting range of P08.13, this warning resets automatically.</td></tr>
<tr><td>Record</td><td>Yes</td></tr>
</table>

Fault Codes

The GS10 drive has a comprehensive fault diagnostic system that include a variety of fault messages. When a fault is detected, the GS10 drive will shut down in order to protect internal components. The following faults are displayed as shown on the GS10 digital keypad display.

For communication errors, “Upper unit” is referring to the Master controller of the serial network. Always ensure the communication settings of the drive (P09.01 and P09.04) match those of the master controller and network.

Gaps in the fault ID numbers below are set aside as “reserved” faults for possible future use. Should your GS10 drive repeatedly display a reserved fault, please note the fault ID number and contact AutomationDirect technical support.

Display on GS10 Keypad	ID No.	Fault Name and Description	Action, Reset, and Corrective Action	
ocA	1	Over-current during acceleration (ocA) Output current exceeds three times of the rated current during acceleration. When ocA occurs, the drive closes the gate of the output immediately, the motor runs freely, and the display shows an ocA error.	Action Level	300% of the rated current
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Reset in five seconds after the fault is cleared
			Record	Yes
			Corrective Actions	1) Check acceleration time. If too short: a) Increase the acceleration time b) Increase the acceleration time of S-curve c) Set auto-acceleration and auto-deceleration parameter (P01.44) d) Set over-current stall prevention function (P06.03) e) Replace the drive with a larger capacity model. 2) Check the motor cable and remove causes of any short circuits, or replace the cable before turning on the power. 3) Check the motor insulation value with megger. Replace the motor if the insulation is poor. 4) Check if the output current during the whole working process exceeds the AC motor drive’s rated current. If yes, replace the AC motor drive with a larger capacity model. 5) Reduce the load or increase the capacity of AC motor drive. 6) Check the motor capacity (the rated current on the motor’s nameplate should ≤ the rated current of the drive). 7) Check the action timing of the contactor and make sure it is not turned ON/OFF when the drive outputs the voltage. 8) Adjust the V/F curve setting and frequency/voltage. When the fault occurs, and the frequency voltage is too high, reduce the voltage. 9) Adjust the torque compensation (refer to P07.26 torque compensation gain) until the output current reduces and the motor does not stall. 10) Verify the wiring of the control circuit and the wiring/grounding of the main circuit to prevent interference. 11) Enable speed tracking during start-up of P07.12. 12) Correct the parameter settings for speed tracking. a) Start the speed tracking function. b) Adjust the maximum current for P07.09 speed tracking. 13) Check the settings for P00.11 control mode: a) For IM, P00.11=0, 1, 2 b) For PM, P00.11=2 14) Increase the AC motor drive’s capacity. 15) Install AC reactor(s) on the output side (U/V/W).

(continued next page)

Fault Codes (continued)				
Display on GS10 Keypad	**ID No.**	**Fault Name and Description**	**Action, Reset, and Corrective Action**	
ocA	1	ocA (continued)	Corrective Actions (cont'd)	16) In the case of hardware failure, the ocA occurs due to the short circuit or ground fault at the output side of the drive. a) Check for possible short circuits between terminals with the electric meter: b) B1 corresponds to U, V and W; DC- corresponds to U, V and W; corresponds to U, V and W. c) If short circuit occurs, contact AutomationDirect Technical Support. 17) Check the stall prevention setting and set the stall prevention to the proper value.
ocd	2	Over-current during deceleration (ocd) Output current exceeds three times of the rated current during deceleration. When ocd occurs, the drive closes the gate of the output immediately, the motor runs freely, and the display shows an ocd error.	Action Level	300% of the rated current
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Reset in five seconds after the fault is cleared
			Record	Yes
			Corrective Actions	1) Check if the deceleration time is too short. If so: a) Increase the deceleration time b) Increase the deceleration time of S-curve c) Set auto-acceleration and auto-deceleration parameter (P01.44) d) Set over-current stall prevention function (P06.03) e) Replace the drive with a larger capacity model 2) Check if the mechanical brake of the motor activates too early. 3) Check the motor cable and remove causes of any short circuits, or replace the cable before turning on the power. 4) Check the motor insulation value with megger. Replace the motor if the insulation is poor. 5) Check if the output current during the whole working process exceeds the AC motor drive's rated current. If yes, replace the AC motor drive with a larger capacity model. 6) Check the impulsive change of the load and reduce the load or increase the capacity of AC motor drive as needed. 7) Verify the motor capacity, the rated current on the motor's nameplate should ≤ the rated current of the drive. 8) If using an ON/OFF controller at the (U/V/W) drive output, check the action timing of the contactor and make sure it is not turned ON/OFF when the drive outputs the voltage. 9) Adjust the V/F curve settings and frequency/voltage. When the fault occurs, and the frequency voltage is too high, reduce the voltage. 10) Adjust the P07.26 torque compensation gain until the output current reduces and the motor does not stall. 11) Verify the wiring of the control circuit and the wiring/grounding of the main circuit to prevent interference. 12) Check the length of the motor cable. If it is too long, increase the AC motor drive's capacity or install AC reactor(s) on the output side (U/V/W). 13) In the case of a hardware error, the ocd occurs due to the short circuit or ground fault at the output side of the drive. a) Check for possible short circuits between terminals with the electric meter: b) B1 corresponds to U, V and W; DC- corresponds to U, V and W; corresponds to U, V and W. c) If short circuits occurs, contact AutomationDirect Technical Support. 14) Verify the stall prevention setting and set the stall prevention to the proper value.

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Fault Codes (continued)				
Display on GS10 Keypad	***ID No.***	***Fault Name and Description***	***Action, Reset, and Corrective Action***	
ocn	3	Over-current during steady operation (ocn) Output current exceeds three times of the rated current during constant speed. When ocn occurs, the drive closes the gate of the output immediately, the motor runs freely, and the display shows an ocn error.	Action Level	300% of the rated current
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Reset in five seconds after the fault is cleared
			Record	Yes
			Corrective Actions	1) Check the motor cable and remove causes of any short circuits, or replace the cable before turning on the power. 2) Check for possible shaft lock, burnout or aging insulation of the motor. a) Check the motor insulation value with megger. Replace the motor if the insulation is poor. 3) Check for impulsive change of the load, and reduce the load or increase the capacity of AC motor drive. 4) Check motor capacity (the rated current on the motor's nameplate should ≤ the rated current of the drive) 5) If using an ON/OFF controller at the drive output, check the action timing of the contactor and make sure it is not turned ON/OFF when the drive outputs the voltage. 6) Adjust the V/F curve settings and frequency/voltage. When the fault occurs, and the frequency voltage is too high, reduce the voltage. 7) Adjust P07.26 torque compensation gain until the output current reduces and the motor does not stall. 8) Verify the wiring of the control circuit and the wiring/grounding of the main circuit to prevent interference. 9) Check the length of the motor cable. If too long: a) Increase the AC motor drive's capacity. b) Install AC reactor(s) on the output side (U/V/W). 10) In the case of hardware failure, the ocn may occur due to a short circuit or ground fault at the output side of the drive. a) Check for possible short circuit between terminals with the electric meter: b) B1 corresponds to U, V and W; DC- corresponds to U, V, and W; corresponds to U, V, and W. c) If short circuits occurs, contact AutomationDirect Technical Support.
GFF	4	Ground fault (GFF) When the drive detects grounding short circuit on the output terminals (U/V/W), the drive closes the gate of the output immediately, the motor runs freely, and the display shows a GFF error.	Action Level	N/A
			Action Time	N/A
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Reset in five seconds after the fault is cleared
			Record	Yes
			Corrective Actions	1) Check for motor burnout or aging insulation. a) Check the motor insulation value with megger. b) Replace the motor if the insulation is poor. 2) Check the cable for short circuits and replace the cable if needed. 3) If the motor cable length exceeds 100 m, decrease the setting value for the carrier frequency and take remedies to reduce stray capacitance. 4) Verify the grounding and wiring of the communication circuit. Separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance. 5) Cycle the power after checking the status of motor, cable, and cable length. If GFF still exists, contact AutomationDirect Technical Support. 6) Refer to the corrective actions for ocn. 7) Refer to the corrective actions for ocA. 8) Refer to the corrective actions for ocd.

(continued next page)

Fault Codes (continued)				
Display on GS10 Keypad	***ID No.***	***Fault Name and Description***	***Action, Reset, and Corrective Action***	
ocS	6	Over-current at stop (ocS) Over-current or hardware failure in current detection at stop. Cycle the power after ocS occurs. If the hardware failure occurs, the display shows cd1, cd2 or cd3.	Action Level	300% of the rated current
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Reset in five seconds after the fault is cleared
			Record	Yes
			Corrective Actions	1) Verify the wiring of the control circuit and the wiring/grounding of the main circuit to prevent interference. 2) Check if other error codes such as cd1–cd3 occur after cycling the power. If yes, return to the factory for repair.
ovA	7	Over-voltage during acceleration (ovA) DC bus over-voltage during acceleration. When ovA occurs, the drive closes the gate of the output, the motor runs freely, and the display shows an ovA error.	Action Level	120V/230V series: 410VDC 460V series: 820VDC
			Action Time	Immediately act when the DC bus voltage is higher than the level
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Reset only when the DC bus voltage is lower than 90% of the over-voltage level
			Record	Yes
			Corrective Actions	1) Check acceleration. If too slow: a) Decrease the acceleration time b) Use a braking unit or DC bus c) Replace the drive with a larger capacity model. 2) Check the setting for stall prevention level. If the value is lower than no-load current, adjust it to be higher than no-load current. 3) Check if the input voltage is within the rated AC motor drive input voltage range, and check for possible voltage spikes. 4) If the phase-in capacitor or active power supply unit acts in the same power system, the input voltage may surge abnormally in a short time. In this case, install an AC reactor. 5) Check for regenerative voltage of motor inertia. If regenerative voltage is being generated: a) Use over-voltage stall prevention function (P06.01) b) Use auto-acceleration and auto-deceleration setting (P01.44) c) Use a braking unit or DC bus 6) Check if the over-voltage Fault occurs after acceleration stops, which indicates acceleration time is too short. Do the following: a) Increase the acceleration time b) Set P06.01 over-voltage stall prevention c) Increase the setting value for P01.25 S-curve acceleration arrival time 2 7) The ground short circuit current charges the capacitor in the main circuit through the power. Check if there is a ground fault on the motor cable, wiring box, or its internal terminals. 8) If using a braking resistor or brake unit, check the wiring. 9) Verify the wiring of the control circuit and the wiring/grounding of the main circuit to prevent interference.

(continued next page)

<table>
<tr><th colspan="5">Fault Codes (continued)</th></tr>
<tr><th>Display on GS10 Keypad</th><th>ID No.</th><th>Fault Name and Description</th><th colspan="2">Action, Reset, and Corrective Action</th></tr>
<tr><td rowspan="7">oud</td><td rowspan="7">8</td><td rowspan="7">Over-voltage during deceleration (ovd)

DC bus over-voltage during deceleration. When ovd occurs, the drive closes the gate of the output immediately, the motor runs freely, and the display shows an ovd error.</td><td>Action Level</td><td>120V/230V series: 410VDC
460V series: 820VDC</td></tr>
<tr><td>Action Time</td><td>Immediately act when the DC bus voltage is higher than the level</td></tr>
<tr><td>Fault setting parameter</td><td>N/A</td></tr>
<tr><td>Reset method</td><td>Manual reset</td></tr>
<tr><td>Reset condition</td><td>Reset only when the DC bus voltage is lower than 90% of the over-voltage level</td></tr>
<tr><td>Record</td><td>Yes</td></tr>
<tr><td>Corrective Actions</td><td>1) Deceleration time may be too short, resulting in too much regenerative energy.
a) Increase the setting value of P01.13, P01.15, P01.17 and P01.19 (deceleration time)
b) Connect a braking resistor, braking unit or DC bus on the drive.
c) Reduce the braking frequency.
d) Replace the drive with a larger capacity model.
e) Use S-curve acceleration/deceleration.
f) Use over-voltage stall prevention (P06.01).
g) Use auto-acceleration and auto-deceleration (P01.44).
h) Adjust the braking level (P07.01 or the bolt position of the braking unit).
2) Verify that the setting for stall prevention level is larger than no-load current
3) Check if the input voltage is within the rated AC motor drive input voltage range, and check for possible voltage spikes.
4) If the phase-in capacitor or active power supply unit acts in the same power system, the input voltage may surge abnormally in a short time. In this case, install an AC reactor.
5) The ground short circuit current charges the capacitor in the main circuit through the power. Check if there is ground fault on the motor cable, wiring box, or its internal terminals.
6) If using a braking resistor or braking unit, check the wiring.
7) Verify the wiring of the control circuit and the wiring/grounding of the main circuit to prevent interference.</td></tr>
<tr><td rowspan="7">oun</td><td rowspan="7">9</td><td rowspan="7">Over-voltage during constant speed (ovn)

DC bus over-voltage at constant speed. When ovn occurs, the drive closes the gate of the output immediately, the motor runs freely, and the display shows an ovn error.</td><td>Action Level</td><td>120V/230V series: 410VDC
460V series: 820VDC</td></tr>
<tr><td>Action Time</td><td>Immediately act when the DC bus voltage is higher than the level</td></tr>
<tr><td>Fault setting parameter</td><td>N/A</td></tr>
<tr><td>Reset method</td><td>Manual reset</td></tr>
<tr><td>Reset condition</td><td>Reset only when the DC bus voltage is lower than 90% of the over-voltage level</td></tr>
<tr><td>Record</td><td>Yes</td></tr>
<tr><td>Corrective Actions</td><td>1) Check for impulsive change of the load, then do the following:
a) Connect a brake resistor, braking unit or DC bus to the drive.
b) Reduce the load.
c) Replace the drive with a larger capacity model.
d) Adjust the braking level (P07.01 or bolt position of the brake unit).
2) Verify the stall prevention level setting is higher than no-load current.
3) Check for regenerative voltage, then enable over-voltage stall prevention function (P06.01) or use a braking unit or DC bus
4) Check if the input voltage is within the rated AC motor drive input voltage range, and check for possible voltage spikes.
5) If the phase-in capacitor or active power supply unit acts in the same power system, the input voltage may surge abnormally in a short time. In this case, install an AC reactor.
6) The ground short circuit current charges the capacitor in the main circuit through the power. Check if there is ground fault on the motor cable, wiring box, or its internal terminals.
7) If using a braking resistor or braking unit, check the wiring.
8) Verify the wiring of the control circuit and the wiring/grounding of the main circuit to prevent interference.</td></tr>
<tr><td colspan="5">(continued next page)</td></tr>
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Fault Codes (continued)				
Display on GS10 Keypad	***ID No.***	***Fault Name and Description***	***Action, Reset, and Corrective Action***	
ouS	10	Over-voltage at stop (ovS) Over-voltage at stop	Action Level	120V/230V series: 410VDC 460V series: 820VDC
			Action Time	Immediately act when the DC bus voltage is higher than the level
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Reset only when the DC bus voltage is lower than 90% of the over-voltage level
			Record	Yes
			Corrective Actions	1) Check if the input voltage is within the rated AC motor drive input voltage range, and check for possible voltage spikes. 2) If the phase-in capacitor or active power supply unit acts in the same power system, the input voltage may surge abnormally in a short time. In this case, install an AC reactor. 3) The ground short circuit current charges the capacitor in the main circuit through the power. Check if there is ground fault on the motor cable, wiring box, or its internal terminals. 4) If using a braking resistor or braking unit, check the wiring. 5) Verify the wiring of the control circuit and the wiring/grounding of the main circuit to prevent interference. 6) Check if other error codes such as cd1–cd3 occur after cycling the power. If yes, contact AutomationDirect Technical Support.
LuA	11	Low-voltage during acceleration (LvA) DC bus voltage is lower than P06.00 setting value during acceleration	Action Level	P06.00 (120V/230V series = 180VDC 460V series = 360VDC
			Action Time	Immediately act when the DC bus voltage is lower than P06.00
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Reset when the DC bus voltage is higher than P06.00 + 30 V
			Record	Yes
			Corrective Actions	1) Improve power supply condition. 2) Adjust voltage to the power range of the drive 3) Check the power system and increase the capacity of power equipment if needed. 4) The load may be too heavy. If so: a) Reduce the load. b) Increase the drive capacity. c) Increase the acceleration time. 5) Check the DC bus and install DC reactor(s). 6) Check for a short circuit plate or DC reactor installed between terminal +1 and +2. Connect short circuit plate or DC reactor between terminal +1 and +2. 7) If the error still exists, contact AutomationDirect Technical Support.
Lud	12	Low-voltage during deceleration (Lvd) DC bus voltage is lower than P06.00 setting value during deceleration	Action Level	P06.00 (120V/230V series = 180VDC 460V series = 360VDC
			Action Time	Immediately act when the DC bus voltage is lower than P06.00
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Reset when the DC bus voltage is higher than P06.00 + 30 V
			Record	Yes
			Corrective Actions	1) Improve power supply condition. 2) Adjust voltage to the power range of the drive 3) Check the power system and increase the capacity of power equipment if needed. 4) The fault may be triggered by sudden load. If so: a) Reduce the load. b) Increase the drive capacity. 5) Check the DC bus and install DC reactor(s).

(continued next page)

Fault Codes (continued)				
Display on GS10 Keypad	***ID No.***	***Fault Name and Description***	***Action, Reset, and Corrective Action***	
Lun	13	Low-voltage at constant speed (Lvn) DC bus voltage is lower than P06.00 setting value at constant speed	Action Level	P06.00 (120V/230V series = 180VDC 460V series = 360VDC
			Action Time	Immediately act when the DC bus voltage is lower than P06.00
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Reset when the DC bus voltage is higher than P06.00 + 30 V
			Record	Yes
			Corrective Actions	1) Improve power supply condition. 2) Adjust voltage to the power range of the drive 3) Check the power system and increase the capacity of power equipment if needed. 4) The fault may be triggered by sudden load. If so: a) Reduce the load. b) Increase the drive capacity. 5) Check the DC bus and install DC reactor(s).
LuS	14	Low-voltage at stop (LvS) DC bus voltage is lower than P06.00 setting value at stop or a hardware failure in voltage detection had occurred.	Action Level	P06.00 (120V/230V series = 180VDC 460V series = 360VDC
			Action Time	Immediately act when the DC bus voltage is lower than P06.00
			Fault setting parameter	N/A
			Reset method	Manual / Auto: 120V/230V series: Lv level + 30VDC + 500ms 460V series: Lv level + 60VDC + 500ms
			Reset condition	500 ms
			Record	Yes
			Corrective Actions	1) Improve power supply condition. 2) Check if the power specification matches the drive. 3) Adjust voltage to the power range of the drive. 4) Cycle the power after checking the power. If LvS error still exists, return to the factory for repair. 5) Check the power system. 6) Increase the capacity of power equipment. 7) Install DC reactor(s).
orP	15	Phase loss protection (orP) Phase loss of power input	Action Level	When DC bus ripple is higher than the protection level, and the output current exceeds 50% of the rated current, the drive starts counting. When the counting value reaches the upper limit, an orP error occurs.
			Action Time	The action time varies with different output current.
			Fault setting parameter	P06.53
			Reset method	Manual reset
			Reset condition	Immediately reset when DC bus is higher than P07.00
			Record	Yes
			Corrective Actions	1) Verify the wiring of the main circuit power is installed correctly. 2) Check that a single-phase power supply is not being used with a three-phase model. Choose the model whose power matches the voltage. 3) Power voltage changes can trigger this fault. If the main circuit power works normally, verify the main circuit. Cycle the power after checking the power, if orP error still exists, contact AutomationDirect Technical Support. 4) Check for loose terminal wiring, tighten the terminal screws according to the torque described in the user manual. 5) Verify the input cable is undamaged and replace if needed. 6) Check for unbalanced three-phase input power.

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Fault Codes (continued)				
Display on GS10 Keypad	***ID No.***	***Fault Name and Description***	***Action, Reset, and Corrective Action***	
oH1	16	IGBT overheating (oH1) IGBT temperature exceeds the protection level. Protection level is model default of P06.15 + 5°C	Action Level	Depending on the model power, model default of P06.15 +5°C. When the setting for P06.15 is higher than the oH1 level, oH1 error occurs instead of oH1 warning. An IGBT overheating error occurs, and the drive stops.
			Action Time	Immediately when limit is reached.
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Reset only when IGBT temperature is lower than oH1 error level minus (-) 10°C
			Record	Yes
			Corrective Actions	1) Check the ambient temperature. 2) Regularly inspect the ventilation hole of the control cabinet. 3) Change the installed location if there are heating objects, such as braking resistors, in the surroundings. 4) Install/add cooling fan or air conditioner to lower the temperature inside the cabinet. 5) Check for and remove obstructions or replace the cooling fan. 6) Increase ventilation space of the drive. 7) Decrease loading. 8) Decrease the carrier wave. 9) Replace the drive with higher capacity model.
tH1o	18	IGBT temperature detection failure (tH1o) IGBT hardware failure in temperature detection	Action Level	NTC broken or wiring failure
			Action Time	When the IGBT temperature is higher than the protection level, and detection time exceeds 100 ms, the tH1o protection activates.
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	Yes
			Corrective Actions	Wait for 10 minutes, and then cycle the power. Check if tH1o protection still exists. If yes, contact AutomationDirect Technical Support.
oL	21	Over load (oL) The AC motor drive detects excessive drive output current. Overload capacity: • Variable Torque (VT): Sustains for one minute when the drive outputs 120% of the drive's rated output current. Sustains for three seconds when the drive outputs 150% of the drive's rated output current. • Constant Torque (CT): Sustains for one minute when the drive outputs 150% of the drive's rated output current. Sustains for three seconds when the drive outputs 200% of the drive's rated output current.	Action Level	Based on overload curve and derating curve.
			Action Time	When the load is higher than the protection level and exceeds allowable time, the oL protection activates.
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Reset in five seconds after the fault is cleared
			Record	Yes
			Corrective Actions	1) Reduce the load. 2) Increase the setting value for P01.12–P01.19 (accel./decel. time) 3) Adjust the settings for P01.01–P01.08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed). Refer to the V/F curve selection of P01.43. 4) Replace the drive with a larger capacity model. 5) If the oL only occurs during low-speed operations: a) Reduce the load during low-speed operation. b) Increase the drive capacity. c) Decrease the carrier frequency of P00.17. 6) Adjust P07.26 Torque Compensation Gain until the output current reduces and the motor does not stall. 7) Verify stall prevention is set to the proper value. 8) Check the status of three-phase motor and verify the cable is not broken or screws are loose. 9) Verify the parameter settings for speed tracking. a) Start the speed tracking function. b) Adjust the maximum current for P07.09 speed tracking.

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Fault Codes (continued)				
Display on GS10 Keypad	**ID No.**	**Fault Name and Description**	**Action, Reset, and Corrective Action**	
EoL1	22	Electronics thermal relay 1 protection (EoL1) Electronics thermal relay 1 protection. The drive coasts to stop once it activates.	Action Level	Start counting when the output current > 150% of the motor 1 rated current
			Action Time	P06.14 (If the output current is larger than 105% of the motor 1 rated current again within 60 sec., the counting time reduces and is less than P06.14)
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Reset in five seconds after the fault is cleared
			Record	Yes
			Corrective Actions	1) Reduce the load. 2) Increase the setting value for P01.12–P01.19 (accel./decel. time) 3) Adjust the settings for P01.01–P01.08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed). Refer to the V/F curve selection of P01.43. 4) If the EoL1 only occurs during low-speed operations: a) Replaced the drive with a dedicated VFD model. b) Increase the motor capacity. 5) If using a VFD dedicated motor, verify P06.13=1: Standard motor (motor with fan on the shaft). 6) Verify motor rated current and reset if needed. 7) Verify motor rated frequency and reset if needed. 8) If using one drive to run multiple motors, set P06.13=2: Disable, and install thermal relay on each motor. 9) Set stall prevention to the proper value. 10) Adjust P07.26 torque compensation gain until the current reduces and the motor does not stall. 11) Check the status of the fan, or replace the fan. 12) Replace the motor.
EoL2	23	Electronic thermal relay 2 protection (EoL2) Electronic thermal relay 2 protection. The drive coasts to stop once it activates.	Action Level	Start counting when the output current > 150% of the motor 2 rated current
			Action Time	P06.28 (If the output current is larger than 105% of the motor 2 rated current again within 60 sec., the counting time reduces and is less than P06.28)
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Reset in five seconds after the fault is cleared
			Record	Yes
			Corrective Actions	1) Reduce the load. 2) Increase the setting value for P01.12–P01.19 (accel./decel. time) 3) Adjust the settings for P01.35–P01.42 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed). Refer to the V/F curve selection of P01.43. 4) If the EoL2 only occurs during low-speed operations: a) Replaced the drive with a dedicated VFD model. b) Increase the motor capacity. 5) If using a VFD dedicated motor, verify P06.27=1: Standard motor (motor with fan on the shaft). 6) Verify motor rated current and reset if needed. 7) Verify motor rated frequency and reset if needed. 8) If using one drive to run multiple motors, set P06.27=2: Disable, and install thermal relay on each motor. 9) Set stall prevention to the proper value. 10) Adjust P07.71 torque compensation gain until the current reduces and the motor does not stall. 11) Check the status of the fan, or replace the fan. 12) Replace the motor.

(continued next page)

Fault Codes (continued)				
Display on GS10 Keypad	**ID No.**	**Fault Name and Description**	**Action, Reset, and Corrective Action**	
oH3	24_1	Motor overheating (oH3) PTC Motor overheating (PTC) (P03.00–P03.01=6 PTC), when PTC input > P06.30, the fault treatment acts according to P06.29.	Action Level	PTC input value > P06.30 setting (Default = 50%)
			Action Time	Immediately act
			Fault setting parameter	P06.29 setting is: 0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning
			Reset method	When P06.29=0, oH3 is a “Warning”. The “Warning” is automatically cleared. When P06.29=1 or 2, oH3 is a “Fault”. You must reset manually.
			Reset condition	Immediately reset
			Record	When P06.29=1 or 2, oH3 is a “Fault”, and the fault is recorded.
			Corrective Actions	1) Check if motor is locked and remove the motor shaft lock. 2) Verify load and decrease the loading or replace motor with a higher capacity model if load is too high. 3) Verify ambient temperature and change the installation location if there are heating devices in the surroundings, or install/add cooling fan or air conditioner to lower the ambient temperature. 4) Check the cooling system and ensure it’s working normally. 5) Verify the motor fan is working and replace the fan if needed. 6) Verify duration of low speed operation. a) Decrease low-speed operation time. b) Change to dedicated motor for the drive. c) Increase the motor capacity. 7) Verify accel/decel time and increase setting values for P01.12–P01.19 (accel./ decel. time) if working cycle is too short. 8) Verify V/F voltage and adjust settings for P01.01–P01.08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low-speed). 9) Verify the motor rated current matches the motor nameplate and configure the correct rated current value of the motor if needed. 10) Check the connection between PTC thermistor and the heat protection. 11) Verify stall prevention is set correctly and adjust the value if needed. 12) Check for unbalanced three-phase motor impedance. Replace the motor if needed. 13) Verify harmonics and reduce harmonics if too high.

(continued next page)

Fault Codes (continued)				
Display on GS10 Keypad	**ID No.**	**Fault Name and Description**	**Action, Reset, and Corrective Action**	
oH3	24_2	Motor overheating (oH3) PT100 RTD Motor overheating (PT100) (P03.00–P03.01=11 PT100). When PT100 input > P06.57 (default = 7V), the fault treatment acts according to P06.29.	Action Level	PT100 RTD input value > P06.57 setting (default = 7V)
			Action Time	Immediately act
			Fault setting parameter	P06.29 setting is: 0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning
			Reset method	When P06.29=0 and the temperature < P06.56, oH3 is automatically cleared. When P06.29=1 or 2, oH3 is a "Fault". You must reset manually.
			Reset condition	Immediately reset
			Record	When P06.29=1 or 2, oH3 is a "Fault", and the fault is recorded.
			Corrective Actions	1) Check if motor is locked and remove the motor shaft lock. 2) Verify load and decrease the loading or replace motor with a higher capacity model if load is too high. 3) Verify ambient temperature and change the installation location if there are heating devices in the surroundings, or install/add cooling fan or air conditioner to lower the ambient temperature. 4) Check the cooling system and ensure it's working normally. 5) Verify the motor fan is working and replace the fan if needed. 6) Verify duration of low speed operation. a) Decrease low-speed operation time. b) Change to dedicated motor for the drive. c) Increase the motor capacity. 7) Verify accel/decel time and increase setting values for P01.12–P01.19 (accel./ decel. time) if working cycle is too short. 8) Verify V/F voltage and adjust settings for P01.01–P01.08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low-speed). 9) Verify the motor rated current matches the motor nameplate and configure the correct rated current value of the motor if needed. 10) Check the connection of PT100 RTD. 11) Verify stall prevention is set correctly and adjust the value if needed. 12) Check for unbalanced three-phase motor impedance. Replace the motor if needed. 13) Verify harmonics and reduce harmonics if too high.
ot1	26	Over torque 1 (ot1) When the output current exceeds the over-torque detection level (P06.07) and exceeds over-torque detection time (P06.08), and when P06.06 or P06.09 is set to 2 or 4, the ot1 error displays.	Action Level	P06.07
			Action Time	P06.08
			Fault setting parameter	P06.06 setting is: 0: No function 1: Continue operation after over-torque detection during constant speed operation 2: Stop after over-torque detection during constant speed operation 3: Continue operation after over-torque detection during RUN 4: Stop after over-torque detection during RUN
			Reset method	When P06.06=1 or 3, ot1 is a "Warning". The warning is automatically cleared when the output current < (Pr.06-07 – 5%) When P06.06=2 or 4, ot1 is a "Fault". You must reset manually.
			Reset condition	Immediately reset
			Record	When P06.06=2 or 4, ot1 is a "Fault", and the fault is recorded.
			Corrective Actions	1) Verify the settings for P06.07 and P06.08. 2) Check for mechanical failure and remove any causes of malfunction. 3) Reduce the load or replace the motor with a higher capacity model. 4) Increase the setting values for P01.12–P01.19 (accel./decel. time) 5) Adjust the V/F curve (Motor 1, P01.01–P01.08), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed). 6) If error occurs during low-speed operation: a) Decrease low-speed operation time. b) Increase the motor capacity. 7) Adjust P07.26 torque compensation gain until the current reduces and the motor does not stall. 8) Very speed tracking settings and correct the parameter settings as needed. a) Start the speed tracking function. b) Adjust the maximum current for P07.09 speed tracking.

(continued next page)

Fault Codes (continued)				
Display on GS10 Keypad	***ID No.***	***Fault Name and Description***	***Action, Reset, and Corrective Action***	
ot2	27	Over torque 2 (ot2) When the output current exceeds the over-torque detection level (P06.10) and exceeds over-torque detection time (P06.11), and when P06.09 is set to 2 or 4, the ot2 error displays.	Action Level	P06.10
			Action Time	P06.11
			Fault setting parameter	P06.09 setting is: 0: No function 1: Continue operation after over-torque detection during constant speed operation 2: Stop after over-torque detection during constant speed operation 3: Continue operation after over-torque detection during RUN 4: Stop after over-torque detection during RUN
			Reset method	When P06.09=1 or 3, ot2 is a “Warning”. The warning is automatically cleared when the output current < (P06.10 – 5%). When P06.09=2 or 4, ot2 is a “Fault”. You must reset manually.
			Reset condition	Immediately reset
			Record	When P06.09=2 or 4, ot2 is a “Fault”, and the fault is recorded.
			Corrective Actions	1) Verify the settings for P06.10 and P06.11. 2) Check for mechanical failure and remove any causes of malfunction. 3) Reduce the load or replace the motor with a higher capacity model. 4) Increase the setting values for P01.12–P01.19 (accel./decel. time) 5) Adjust the V/F curve (Motor 1, P01.35–P01.42), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed). 6) If error occurs during low-speed operation: a) Decrease low-speed operation time. b) Increase the motor capacity. 7) Adjust P07.71 torque compensation gain until the current reduces and the motor does not stall. 8) Very speed tracking settings and correct the parameter settings as needed. a) Start the speed tracking function. b) Adjust the maximum current for P07.09 speed tracking.
uC	28	Under current (uC) Low current detection	Action Level	P06.71
			Action Time	P06.72
			Fault setting parameter	P06.73 setting is: 0: No function 1: Fault and coast to stop 2: Fault and ramp to stop by the 2nd deceleration time 3: Warn and continue operation
			Reset method	When P06.73=3, uC is a “Warning”. The warning is automatically cleared when the output current > (P06.71+0.1A). When P06.73=1 or 2, uC is a “Fault”. You must reset manually.
			Reset condition	Immediately reset
			Record	When P06.71=1 or 2, uC is a “Fault”, and the fault is recorded.
			Corrective Actions	1) Confirm the motor cable is connected properly. 2) Verify settings of P06.71, P06.72, and P06.73 and set to correct values if needed. 3) Check if the load is too low and whether the motor capacity matches the load.
cF2	31	EEPROM read error (cF2) Internal EEPROM cannot be read	Action Level	Firmware internal detection
			Action Time	cF2 acts immediately when the drive detects the fault
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	Yes
			Corrective Actions	1) Press “RESET” key or reset the parameter to the default setting. If cF2 still occurs, contact AutomationDirect Technical Support. 2) Cycle the power, if cF2 error still occurs, contact AutomationDirect Technical Support.

(continued next page)

Fault Codes (continued)				
Display on GS10 Keypad	**ID No.**	**Fault Name and Description**	**Action, Reset, and Corrective Action**	
cd1	33	U-phase error (cd1) U-phase current detection error when power is ON	Action Level	Hardware detection
			Action Time	cd1 acts immediately when the drive detects the fault
			Fault setting parameter	N/A
			Reset method	Power-off
			Reset condition	N/A
			Record	Yes
			Corrective Actions	Cycle the power, if cd1 error still occurs, contact AutomationDirect Technical Support.
cd2	34	V-phase error (cd2) V-phase current detection error when power ON	Action Level	Hardware detection
			Action Time	cd2 acts immediately when the drive detects the fault
			Fault setting parameter	N/A
			Reset method	Power-off
			Reset condition	N/A
			Record	Yes
			Corrective Actions	Cycle the power, if cd2 error still occurs, contact AutomationDirect Technical Support.
cd3	35	W-phase error (cd3) W-phase current detection error when power ON	Action Level	Hardware detection
			Action Time	cd3 acts immediately when the drive detects the fault
			Fault setting parameter	N/A
			Reset method	Power-off
			Reset condition	N/A
			Record	Yes
			Corrective Actions	Cycle the power, if cd3 error still occurs, contact AutomationDirect Technical Support.
Hd0	36	cc hardware error (Hd0) cc (current clamp) hardware protection error when power is ON	Action Level	Hardware detection
			Action Time	Hd0 acts immediately when the drive detects the fault
			Fault setting parameter	N/A
			Reset method	Power-off
			Reset condition	N/A
			Record	Yes
			Corrective Actions	Cycle the power, if Hd0 error still occurs, contact AutomationDirect Technical Support.
Hd1	37	oc hardware error (Hd1) oc hardware protection error when power is ON	Action Level	Hardware detection
			Action Time	Hd1 acts immediately when the drive detects the fault
			Fault setting parameter	N/A
			Reset method	Power-off
			Reset condition	N/A
			Record	Yes
			Corrective Actions	Cycle the power, if Hd1 error still occurs, contact AutomationDirect Technical Support.
AUE	40	Auto-tuning error (AUE) Motor auto-tuning error	Action Level	Hardware detection
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	Yes
			Corrective Actions	1) This error can occur if you press the STOP key during auto-tuning. Re-execute auto-tuning. 2) Check motor capacity and related parameters. a) Set the correct parameters P01.01–P01.02. b) Set P01.00 larger than the motor rated frequency. 3) Check the motor wiring. 4) Check for motor shaft lock and remove cause of lock if needed. 5) Check for electromagnetic contactor at output (U/V/W) and make sure the electromagnetic valve is OFF. 6) Verify load. If too heavy: a) Reduce the load. b) Replace the motor with a larger capacity model. 7) Check if accel/decel time is too short, then increase the setting values for P01.12–P01.19 (accel./decel. time) if needed.

(continued next page)

Fault Codes (continued)				
Display on GS10 Keypad	**ID No.**	**Fault Name and Description**	**Action, Reset, and Corrective Action**	
AFE	41	PID loss AI-C (AFE) PID feedback loss (analog feedback signal is only valid when the PID function is enabled)	Action Level	When the analog input < 4 mA (only detects 4–20 mA analog input)
			Action Time	P08.08
			Fault setting parameter	P08.09 setting is: 0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: Warn and operate at last frequency
			Reset method	When P08.09=3 or 4, AFE is a "Warning". When the feedback signal is > 4 mA, the "Warning" is automatically cleared. When P08.09=1 or 2, AFE is a "Fault". You must reset manually.
			Reset condition	Immediately reset
			Record	When P08.09=1 or 2, AFE is a "Fault", and the fault is recorded; when P08.09=3 or 4, AFE is a "Warning", and the warning is not recorded.
			Corrective Actions	1) Check the PID feedback cable and tighten the terminal. Replace the cable with a new one if needed. 2) Check for feedback device failure and replace the device with a new one. 3) Check all the wiring. If AFE fault still exists, contact AutomationDirect Technical Support.
ACE	48	AI-C loss (ACE) Analog input loss (including all the 4–20 mA analog signal)	Action Level	When the analog input is < 4 mA (only detects 4–20 mA analog input)
			Action Time	Immediately act
			Fault setting parameter	P03.19 setting is: 0: Disable 1: Continue operation at the last frequency (warning, ANL is displayed on the keypad) 2: Decelerate to stop (warning, ANL is displayed on the keypad) 3: Stop immediately and display ACE
			Reset method	When P03.19=1 or 2, ACE is a "Warning". When analog input signal is > 4 mA, the warning is automatically cleared. When P03.19=3, ACE is a "Fault". You must reset manually.
			Reset condition	Immediately reset
			Record	When P03.19=3, ACE is a "Fault", and the fault is recorded.
			Corrective Actions	1) Check the AI2 feedback cable and tighten the terminal. Replace the cable with a new one if needed. 2) Check for external device failure and replace the device with a new one. 3) Check all the wiring. If ACE fault still exists, contact AutomationDirect Technical Support.
EF	49	External fault (EF) External fault. When the drive decelerates based on the setting of P07.20, the EF fault displays on the keypad.	Action Level	DIx=10: External fault (EF) and the DI terminal is ON
			Action Time	Immediately act
			Fault setting parameter	P07.20 setting is: 0: Coast to stop 1: Stop by the 1st deceleration time 2: Stop by the 2nd deceleration time 3: Stop by the 3rd deceleration time 4: Stop by the 4th deceleration time 5: System deceleration 6: Automatic deceleration (P01.46)
			Reset method	Manual reset
			Reset condition	Manual reset only after the external fault is cleared (terminal status is recovered)
			Record	Yes
			Corrective Actions	Press RESET key after the fault is cleared.
EF1	50	Emergency stop (EF1) When the contact of DIx=EF1 is ON, the output stops immediately and displays EF1 on the keypad. The motor is in free running.	Action Level	DIx=28: Emergency Stop (EF1) and the DI terminal is ON
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Manual reset only after the external fault is cleared (terminal status is recovered)
			Record	Yes
			Corrective Actions	Verify if the system is back to normal condition, and then press "RESET" key to go back to the default.

(continued next page)

Fault Codes (continued)

Display on GS10 Keypad	***ID No.***	***Fault Name and Description***	***Action, Reset, and Corrective Action***	
bb	51	External base block (bb) When the contact of DIx=bb is ON, the output stops immediately and displays bb on the keypad. The motor is in free running.	Action Level	DIx=11: Base Block (BB) and the DI terminal is ON
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	The display “bb” is automatically cleared after the fault is cleared.
			Reset condition	N/A
			Record	No
			Corrective Actions	Verify if the system is back to normal condition, and then press “RESET” key to go back to the default.
Pcod	52	Password is locked (Pcod) Entering the wrong password three consecutive times through P00.07	Action Level	Entering the wrong password three consecutive times
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Power-off
			Record	Yes
			Corrective Actions	1) Input the correct password after rebooting the motor drive. 2) If you forget the password, do the following steps: a) Step 1: Input 9999 and press ENTER. b) Step 2: Repeat step 1. Input 9999 and press ENTER. (You need to finish step 1 and step 2 within 10 seconds. If you don’t finish the two steps in 10 seconds, try again.) 3) The parameter settings return to the default when the “Input 9999” process is finished.
CE1	54	Illegal command (CE1) Communication command is illegal	Action Level	When the function code is not 03, 06, 10, or 63.
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	No
			Corrective Actions	1) Check if the communication command is correct. 2) Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance. 3) Check if the setting for P09.04 is the same as the setting for the upper unit. 4) Check the cable and replace it if necessary.
CE2	55	Illegal data address (CE2) Data address is illegal	Action Level	When the data address is correct.
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	No
			Corrective Actions	1) Check if the communication command from the upper limit is correct. 2) Verify the wiring and grounding of the communication circuit. Separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance. 3) Check if the setting for P09.04 is the same as the setting for the upper unit. 4) Check the cable and replace it if necessary.

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Fault Codes (continued)				
Display on GS10 Keypad	**ID No.**	**Fault Name and Description**	**Action, Reset, and Corrective Action**	
CE3	56	Illegal data value (CE3) Data value is illegal	Action Level	When the data length is too long
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	No
			Corrective Actions	1) Check if the communication command from the upper limit is correct. 2) Verify the wiring and grounding of the communication circuit. Separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance. 3) Check if the setting for P09.04 is the same as the setting for the upper unit. 4) Check the cable and replace it if necessary.
CE4	57	Data is written to read-only address (CE4) Data is written to read-only address	Action Level	When the data is written to read-only address.
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	No
			Corrective Actions	1) Check if the communication command from the upper limit is correct. 2) Verify the wiring and grounding of the communication circuit. Separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance. 3) Check if the setting for P09.04 is the same as the setting for the upper unit. 4) Check the cable and replace it if necessary.
CE 10	58	Modbus transmission time-out (CE10) Modbus transmission time-out occurs	Action Level	When the communication time exceeds the detection time for P09.03 communication time-out.
			Action Time	P09.03
			Fault setting parameter	P09.02 0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning, no fault, and continue operation
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	Yes
			Corrective Actions	1) Check if the upper unit transmits the communication command within the setting time for P09.03. 2) Verify the wiring and grounding of the communication circuit. Separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance. 3) Check if the setting for P09.04 is the same as the setting for the upper unit. 4) Check the cable and replace it if necessary.
oSL	63	Over slip error (oSL) On the basis of the maximum slip limit set via P10.29, the speed deviation is abnormal. When the motor drive outputs at constant speed, F>H or F<H exceeds the level set via P07.29, and it exceeds the time set via P07.30, oSL shows. oSL occurs in induction motors only.	Action Level	P07.29 100% of P07.29 = the maximum limit of the slip frequency (P10.29)
			Action Time	P07.30
			Fault setting parameter	P07.31 setting is: 0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning
			Reset method	P07.31=0 is a warning. When the motor drive outputs at constant speed, and F>H or F<H does not exceed the level set via P07.29 anymore, oSL warning will be cleared automatically. When P07.31=1 or 2, oSL is an error, and it needs to reset manually.
			Reset condition	Immediately reset
			Record	P07.31=1 or 2, oSL is “Fault”, and the fault is recorded.
			Corrective Actions	1) Verify the group 5 motor parameters. 2) Decrease the load 3) Check the setting of oSL protection function related parameters P07.29, P07.30, and P10.29
(continued next page)				

<table>
<tr><th colspan="5">Fault Codes (continued)</th></tr>
<tr><th>Display on GS10 Keypad</th><th>ID No.</th><th>Fault Name and Description</th><th colspan="2">Action, Reset, and Corrective Action</th></tr>
<tr><td rowspan="7">Sto</td><td rowspan="7">76</td><td rowspan="7">STO

GS10 does not have STO function.
Fault occurs due to missing jumper on the bypass pins or internal drive problem</td><td>Action Level</td><td>Hardware detection</td></tr>
<tr><td>Action Time</td><td>Immediately act</td></tr>
<tr><td>Fault setting parameter</td><td>N/A</td></tr>
<tr><td>Reset method</td><td>Auto: When P06.44=1 and after STO error is cleared, it automatically resets.
Manual: When P06.44=0 and after STO error is cleared, reset it manually.</td></tr>
<tr><td>Reset condition</td><td>Reset only after STO error is cleared</td></tr>
<tr><td>Record</td><td>Yes</td></tr>
<tr><td>Corrective Actions</td><td>1) Check if bypass pin jumper is correctly installed.
2) If STO fault still exists after cycling the power, please contact ADC"</td></tr>
<tr><td rowspan="7">Aoc</td><td rowspan="7">79</td><td rowspan="7">U-phase over-current before run (Aoc)

U-phase short circuit detected when the output wiring detection is performed before the drive runs.</td><td>Action Level</td><td>300% of the rated current</td></tr>
<tr><td>Action Time</td><td>Immediately act</td></tr>
<tr><td>Fault setting parameter</td><td>N/A</td></tr>
<tr><td>Reset method</td><td>Manual reset</td></tr>
<tr><td>Reset condition</td><td>Reset in five seconds after the fault clears</td></tr>
<tr><td>Record</td><td>Yes</td></tr>
<tr><td>Corrective Actions</td><td>1) Check if the motor's internal wiring and the UVW wiring of the drive output terminal are correct.
2) Check the motor cable and remove causes of any short circuits, or replace the cable before turning on the power.
3) Check the motor insulation value with megger. Replace the motor if the insulation is poor.
4) Verify the wiring of the control circuit and the wiring/grounding of the main circuit to prevent interference.
5) Check the length of the motor cable. If it's too long:
a) Increase the AC motor drive's capacity.
b) Install AC reactor(s) on the output side (U/V/W).
6) The Aoc may occur due to a short circuit or ground fault at the output side of the drive. Check for possible short circuits between terminals with an electric meter:
a) B1 corresponds to U, V and W; DC- corresponds to U, V and W; corresponds to U, V and W.
b) If short circuit occurs, contact AutomationDirect Technical Support.</td></tr>
<tr><td rowspan="7">boc</td><td rowspan="7">80</td><td rowspan="7">V-phase over-current before run (boc)

V-phase short circuit detected when the output wiring detection is performed before the drive runs.</td><td>Action Level</td><td>300% of the rated current</td></tr>
<tr><td>Action Time</td><td>Immediately act</td></tr>
<tr><td>Fault setting parameter</td><td>N/A</td></tr>
<tr><td>Reset method</td><td>Manual reset</td></tr>
<tr><td>Reset condition</td><td>Reset in five seconds after the fault clears</td></tr>
<tr><td>Record</td><td>Yes</td></tr>
<tr><td>Corrective Actions</td><td>1) Check if the motor's internal wiring and the UVW wiring of the drive output terminal are correct.
2) Check the motor cable and remove causes of any short circuits, or replace the cable before turning on the power.
3) Check the motor insulation value with megger. Replace the motor if the insulation is poor.
4) Verify the wiring of the control circuit and the wiring/grounding of the main circuit to prevent interference.
5) Check the length of the motor cable. If it's too long:
a) Increase the AC motor drive's capacity.
b) Install AC reactor(s) on the output side (U/V/W).
6) The Aoc may occur due to a short circuit or ground fault at the output side of the drive. Check for possible short circuits between terminals with an electric meter:
a) B1 corresponds to U, V and W; DC- corresponds to U, V and W; corresponds to U, V and W.
b) If short circuit occurs, contact AutomationDirect Technical Support.</td></tr>
<tr><td colspan="5">(continued next page)</td></tr>
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Fault Codes (continued)				
Display on GS10 Keypad	**ID No.**	**Fault Name and Description**	**Action, Reset, and Corrective Action**	
coc	81	W-phase over-current before run (coc) W-phase short circuit detected when the output wiring detection is performed before the drive runs.	Action Level	300% of the rated current
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Reset in five seconds after the fault clears
			Record	Yes
			Corrective Actions	1) Check if the motor's internal wiring and the UVW wiring of the drive output terminal are correct. 2) Check the motor cable and remove causes of any short circuits, or replace the cable before turning on the power. 3) Check the motor insulation value with megger. Replace the motor if the insulation is poor. 4) Verify the wiring of the control circuit and the wiring/grounding of the main circuit to prevent interference. 5) Check the length of the motor cable. If it's too long: a) Increase the AC motor drive's capacity. b) Install AC reactor(s) on the output side (U/V/W). 6) The Aoc may occur due to a short circuit or ground fault at the output side of the drive. Check for possible short circuits between terminals with an electric meter: a) B1 corresponds to U, V and W; DC- corresponds to U, V and W; corresponds to U, V and W. b) If short circuit occurs, contact AutomationDirect Technical Support.
oPL1	82	Output phase loss U phase (oPL1) U phase output phase loss	Action Level	P06.47
			Action Time	P06.46 P06.48: Use the setting value of P06.48 first. If DC braking function activates, use that of P06.46.
			Fault setting parameter	P06.45 setting is: 0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	P06.45=1 or 2 is "Fault", and the fault is recorded.
			Corrective Actions	1) Check for unbalanced three-phase motor impedance. If unbalanced, replace the motor. 2) Verify motor is wired correctly. Check the cable condition and replace the cable if necessary. 3) Ensure a single-phase motor is not being used with a three-phase drive 4) Check the flat cable of the control board. Re-do the wiring and test again if the flat cable is loose. If the fault still exists, contact AutomationDirect Technical Support. 5) Verify that the three-phase current is balanced with a current clamp meter. If it is balanced and the oPL1 fault still exists, contact AutomationDirect Technical Support. 6) Make sure the capacity of the drive and motor match each other.
(continued next page)				

Fault Codes (continued)				
Display on GS10 Keypad	**ID No.**	**Fault Name and Description**	**Action, Reset, and Corrective Action**	
oPL2	83	Output phase loss V phase (oPL2) V phase output phase loss	Action Level	P06.47
			Action Time	P06.46 P06.48: Use the setting value of P06.48 first. If DC braking function activates, use that of P06.46.
			Fault setting parameter	P06.45 setting is: 0: Warn and keep operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	When P06.45=1 or 2, oPL2 is a "Fault", and the fault is recorded.
			Corrective Actions	1) Check for unbalanced three-phase motor impedance. If unbalanced, replace the motor. 2) Verify motor is wired correctly. Check the cable condition and replace the cable if necessary. 3) Ensure a single-phase motor is not being used with a three-phase drive 4) Check the flat cable of the control board. Re-do the wiring and test again if the flat cable is loose. If the fault still exists, contact AutomationDirect Technical Support. 5) Verify that the three-phase current is balanced with a current clamp meter. If it is balanced and the oPL2 fault still exists, contact AutomationDirect Technical Support. 6) Make sure the capacity of the drive and motor match each other.
oPL3	84	Output phase loss W phase (oPL3) W phase output phase loss	Action Level	P06.47
			Action Time	P06.46 P06.48: Use the setting value of P06.48 first. If DC braking function activates, use that of P06.46.
			Fault setting parameter	P06.45 setting is: 0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	When P06.45=1 or 2, oPL3 is a "Fault", and the fault is recorded.
			Corrective Actions	1) Check for unbalanced three-phase motor impedance. If unbalanced, replace the motor. 2) Verify motor is wired correctly. Check the cable condition and replace the cable if necessary. 3) Ensure a single-phase motor is not being used with a three-phase drive 4) Check the flat cable of the control board. Re-do the wiring and test again if the flat cable is loose. If the fault still exists, contact AutomationDirect Technical Support. 5) Verify that the three-phase current is balanced with a current clamp meter. If it is balanced and the oPL3 fault still exists, contact AutomationDirect Technical Support. 6) Make sure the capacity of the drive and motor match each other.
oL3	87	Low frequency overload protection (oL3) Low frequency and high current protection	Action Level	Software detection
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	Yes
			Corrective Actions	1) Enhance the heat dissipation capacity for the cabinet. 2) Lower the carrier frequency (P00.17). 3) Decrease the voltage settings that correspond to frequency below 15 Hz in the V/F curve. 4) Set P00.11=0 (V/F, general control mode). 5) Replace the drive with a higher power model.

(continued next page)

Display on GS10 Keypad	ID No.	Fault Name and Description	Action, Reset, and Corrective Action	
AUE1	142	Auto-tune error 1 (AuE1) No feedback current error when the motor parameter automatically detects	Action Level	Software detection
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	Yes
			Corrective Actions	1) Verify the motor is wired correctly. 2) If a contactor is used as an open state on the output side of the drive (U/V/W), check if the contactor coil is closed.
AUE2	143	Auto-tune error 2 (AuE2) Motor phase loss error when the motor parameter automatically detects	Action Level	Software detection
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	Yes
			Corrective Actions	1) Verify that the motor is wired correctly and no wires are broken. 2) Confirm that the motor works normally outside of auto-tuning. 3) If an electromagnetic contactor is used as an open state on the output side of the drive (U/V/W), verify that the three phases of the electromagnetic valve are all closed.
AUE5	149	Total resistance measurement fault (AuE5) Fault on measuring total resistance.	Action Level	Software detection
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	Yes
			Corrective Actions	Check if the motor works normally.
AUE6	150	No-load current IO measurement fault (AUE6) Fault on measuring no-load current IO.	Action Level	Software detection
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	Yes
			Corrective Actions	Check if the motor works normally.
AUE7	151	dq axis inductance measurement fault (AUE7) Fault on measuring dq axis inductance	Action Level	Software detection
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	Yes
			Corrective Actions	Check if the motor works normally.
AUE8	152	High frequency injection measurement fault (AUE8) Fault on measuring high frequency injection	Action Level	Software detection
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	Yes
			Corrective Actions	Check if the motor works normally.

(continued next page)

Fault Codes (continued)				
Display on GS10 Keypad	ID No.	Fault Name and Description	Action, Reset, and Corrective Action	
dEu	157	Pump PID feedback error (dEv) Pump PID feedback error	Action Level	Feedback value < target value × (1 - P08.13)
			Action Time	P08.14
			Fault setting parameter	P08.62
			Reset method	Self-recovery or manual reset.
			Reset condition	Set as Warning: Feedback value ≥ target value (1 - P08.13) automatic recovery. Set as Fault: Immediately reset
			Record	Yes
			Corrective Actions	1) Check P08.14 time extension for unreasonable parameter settings. 2) Check if the motor works normally.

Typical AC Drive Problems and Solutions

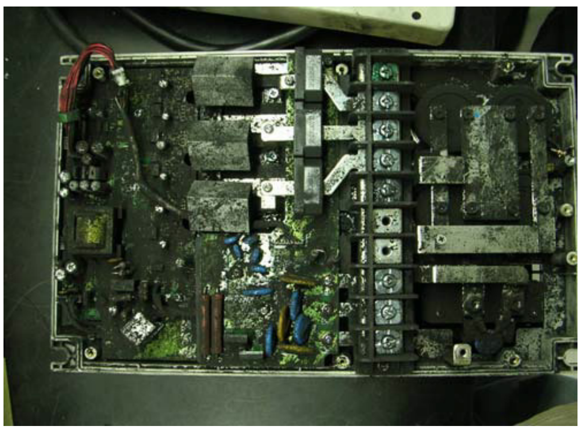
NOTE: Drive photos in this section are not GS10 drives, just typical representative AC drives.

Grease and Dirt Problems

In those industries where grease and dirt are common. Please be aware of the possible damage that grease, oil, and dirt, may cause to your GS10 drive:

1) *Electronic components that silt up with greasy oil may cause the drive to burn out or even explode.*
2) *Most greasy dirt contains corrosive substances that may damage the drive.*

Solution:
Install the GS10 drive in a suitable enclosure to protect it from grease and dirt. Clean and remove grease and dirt regularly to prevent damage of the drive.

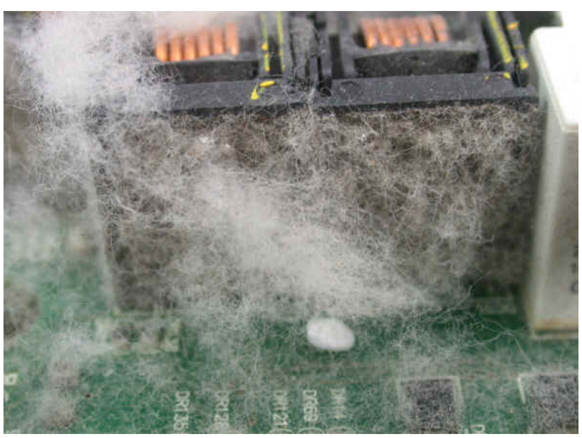


Fiber Dust Problem

Problems related to fiber dust are typical in the textile industry. Please be aware of the possible damage that fiber dust may cause to your GS10 drive:

1) *Fiber dust that accumulates or adheres to the fans will result in poor ventilation and cause overheating problems.*
2) *Textile plant environments with high humidity levels may experience GS10 drive failure or damage as a result of wet fiber dust adhering to components within the drive.*

Solution:
Install the GS10 drive in a suitable enclosure to protect it from fiber dust. Clean and remove fiber dust regularly to prevent damage to the drive.

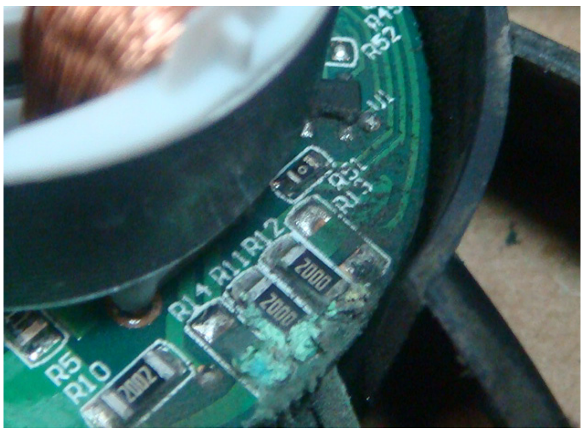


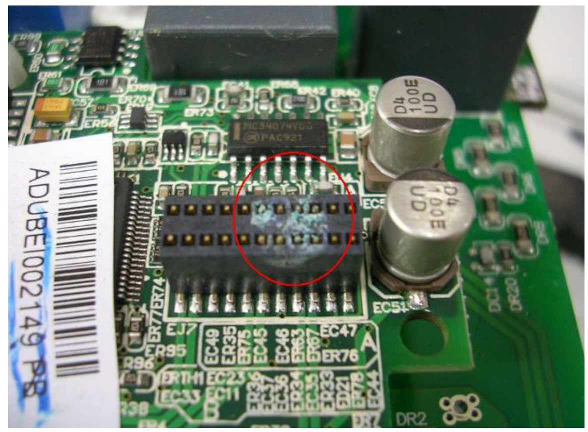
Corrosion Problem

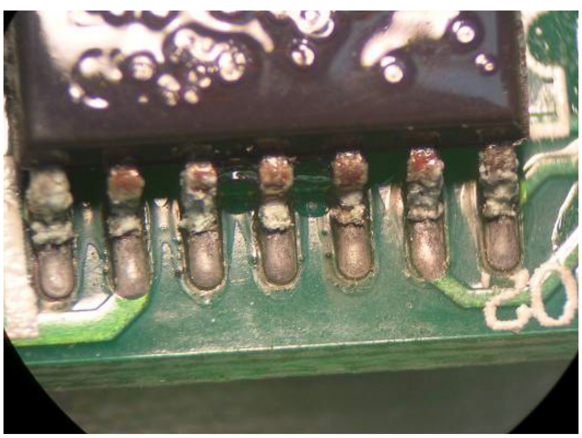
Corrosion problems may occur if any fluids or liquid in vapor form flows into the GS10 drive. Please be aware of the damage that corrosion may cause to your drive.

- *Corrosion of internal components may cause the GS10 drive to malfunction and possibly explode.*

Solution:
Install the GS10 drive in a suitable enclosure to protect it from fluids. Clean the drive regularly to prevent corrosion.





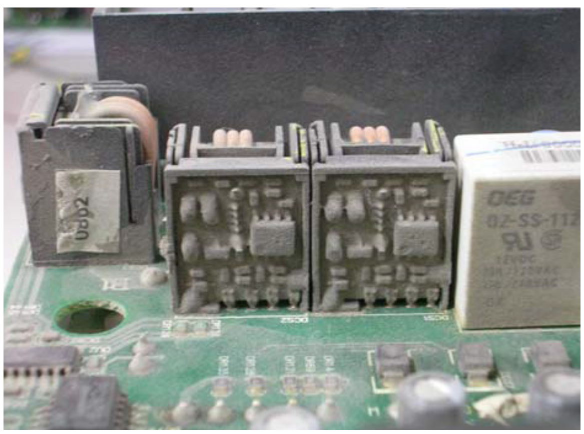


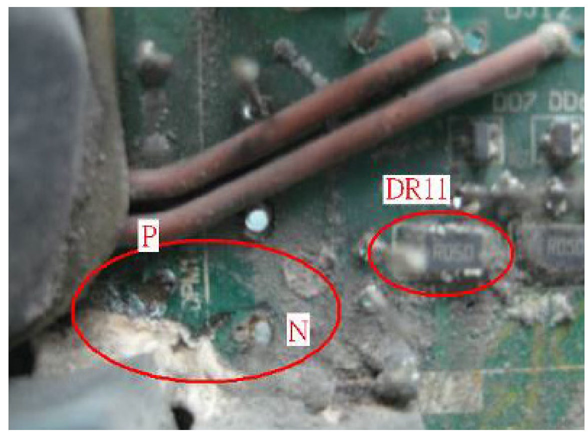
Industrial Dust Problem

Serious industrial dust pollution frequently occurs in stone processing plants, flour mills, cement plants, and so on. Please be particularly aware of any metal dust, filings or if metalized vapor is present as these may cause damage to your drives:

1) *Dust accumulating on electronic components may cause overheating problems and shorten the service life of the drive.*
2) *Conductive dust may damage the circuit board and may cause the drive to explode.*

Solution:
Install the GS10 drive in a suitable enclosure and protect it from dust. Clean the cabinet and ventilation filter regularly for good ventilation.



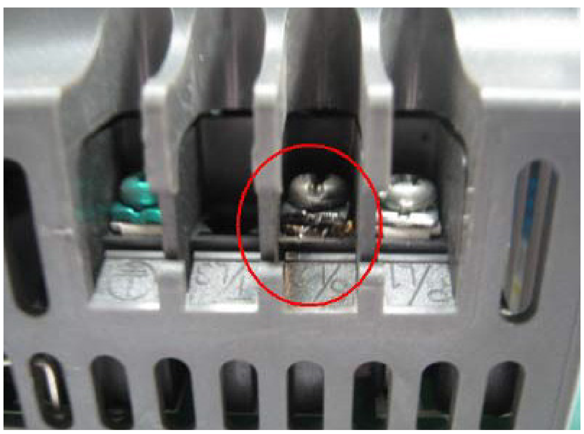


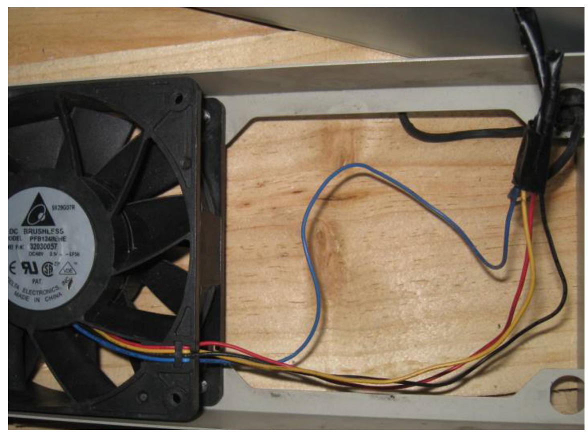
Wiring and Installation Problem

When wiring the GS10 drive, the most common problems are connection to the wrong terminal or poor wiring practice. Please be aware of the possible damage that poor wiring practice may cause to your GS10 drive:

1) *Screw terminals where the wire is not fully inserted or the terminal screw is not adequately tightened may result in sparking or high temperature due to a high resistance connection.*
2) *If circuit boards in the GS10 drive have been modified, components on the affected boards may have been damaged.*

Solution:
Inspect all power and control terminal connections in the GS10 drive to ensure adequate wire insertion. Do not attempt to disassemble or repair control boards in the GS10 drive.





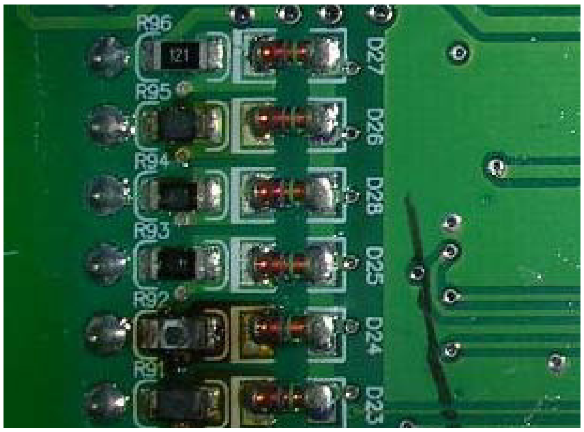
Digital Input/Output Terminal Problems

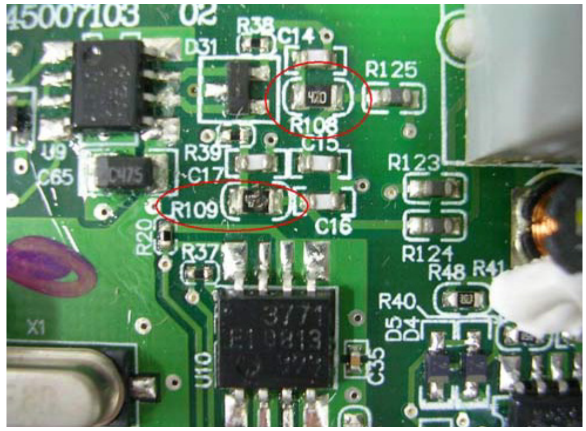
Problems with digital I/O are usually the result of improper termination, or failure to segregate control wiring from power wiring. This may result in errant signals due to induced voltage, capacitive coupling or electrical noise. Incorrect voltage levels applied to the digital I/O terminals can damage the I/O circuitry of the drive.

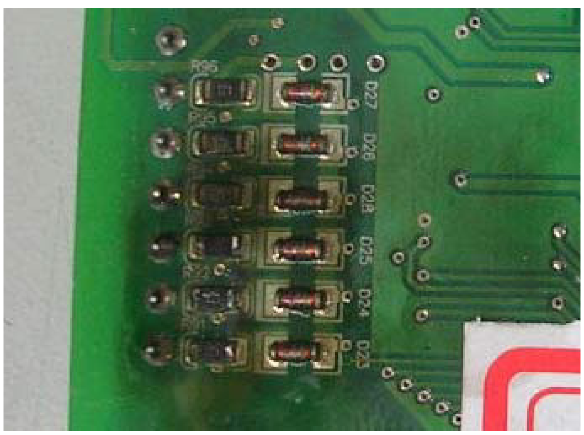
- *Input/Output circuit may burn out when the terminal usage exceeds its limit.*

Solution:

Refer to the user manual for multi-function input output terminals usage and follow the specified voltage and current. DO NOT exceed the specification limits.







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GSoft2 – Getting Started

Chapter 7

Table of Contents

GS10 Drive Configuration Software

GSoft2 is the configuration software for the Automation Direct DuraPULSE GS4, GS10, and GS20 family of AC drives. It is designed to allow you to connect a personal computer to the drive, and perform a variety of functions:

- *Create new drive configurations*
- *Upload/download drive configurations*
- *Edit drive configurations*
- *Archive/store multiple drive configurations on your PC*
- *Trend drive operation parameters*
- *Tune the drive PID loop*
- *View real time key operating parameters*
- *Start/Stop drive and switch directions, provided drive is set up for remote operation*
- *View drive faults*

GSoft2 includes an integral help file with software instructions. GSoft2 can be downloaded for free or purchased on USB card from AutomationDirect.com (search for GSoft2). Use version 2.0.0.6 or higher for use with GS10.

System Requirements

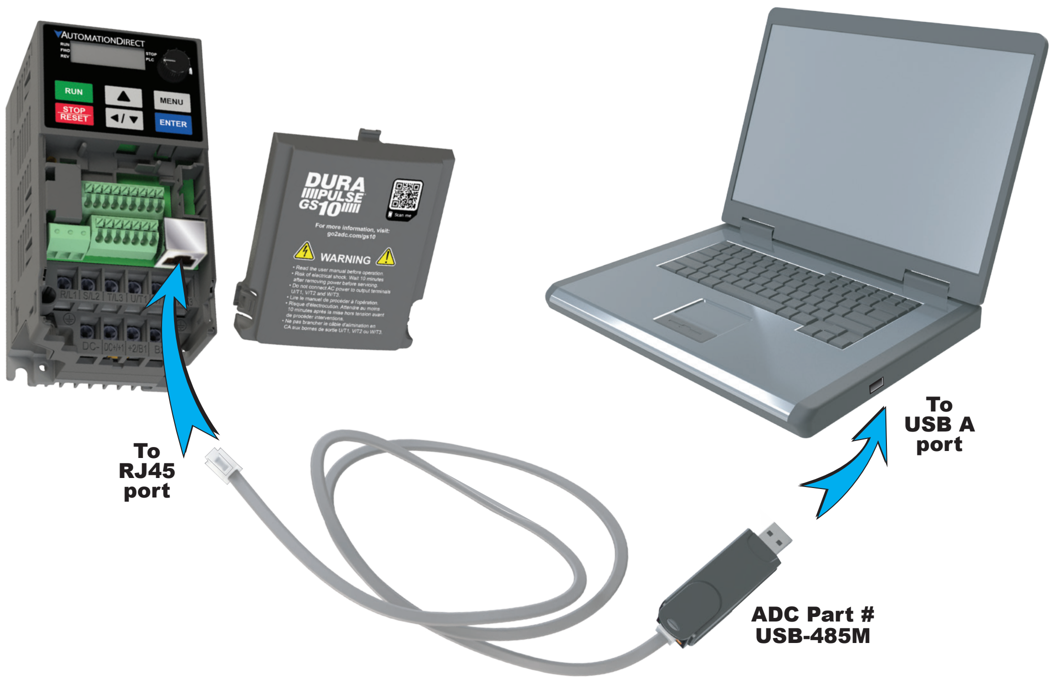
GSoft2 will run on PCs that meet the following requirements:

- *Windows OS: **8**: 32 & 64 bit, **8.1**: 32 & 64 bit, **10**: 64 bit, **11**: 64 bit*
- *Edge or Chrome (for HTML help support)*
- *32 Mb of available memory*
- *10 Mb hard drive space*
- *Available USB port*

Installation Guide

System Requirement Configuration

Connect the GS10 drive to a PC/Laptop computer by using the USB-485M, (USB A to RS-485 serial adapter). Connect the USB adapter into your PC USB slot and use the supplied RJ45 cable to connect the adapter to the GS10 port.



GS10 Communication Settings for GSoft2 - Quick Reference

To connect the GS10 to GSoft2, the following communication settings are required:

Drive Parameter Configuration

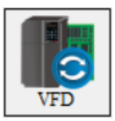
Use the "CONNECT" button on the toolbar to connect the drive. P09.01 and P09.04 must be set to the values below for communications (these are the default values).

- *P09.01 - Comm Speed = 38.4 Kpbs.*
- *P09.04 - Comm Protocol = 13 (8,N,2 - RTU)*

NOTE: These are the default values of the drive.

NOTE: If necessary, GSoft 2 will adjust parameters P09.01 and P09.04 to match the above settings if "Auto Connect" is used. See "Icon Functions" on page 7-8 for more details.

For Firmware Upgrade



Use the "VFD" button on the toolbar to update the firmware. P09.01 and P09.04 must be set to the values below BEFORE updating firmware.

- *Set P09.01 - Comm Speed = 38.4 Kpbs*
- *Set P09.04- Comm Protocol = 6 (8,N,1- ASCII)*

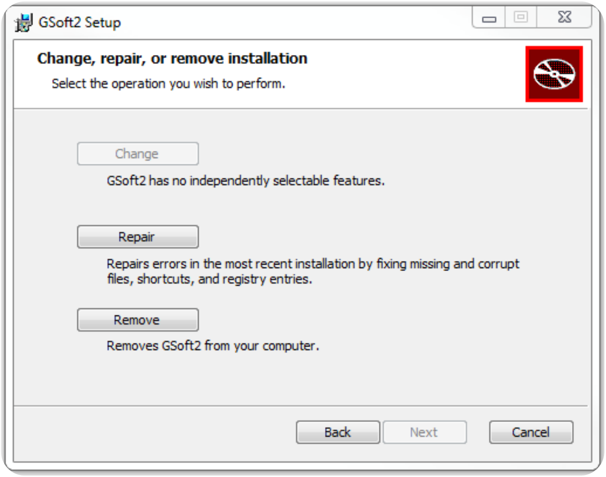
NOTE: Drive should remain powered on during FW upgrade.

Software Installation

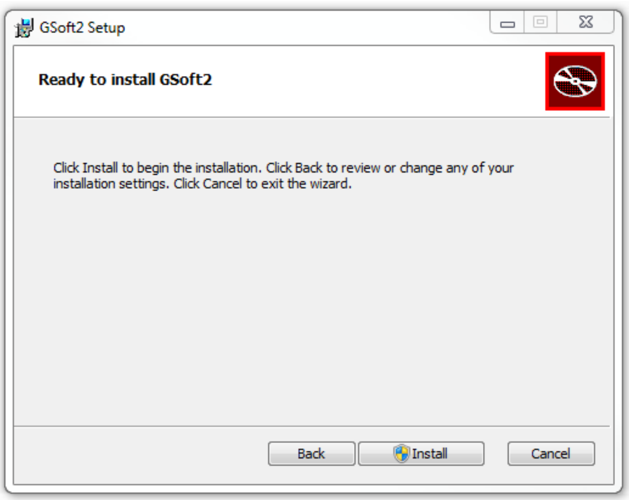
Step 1: Download the installation file from AutomationDirect.com or place the GSoft2 USB into your PC. If Autoplay is not enabled, doubleclick Setup.msi to start the installation process.

Step 2: Proceed with installation. At the welcome dialogue box select NEXT to continue installation process.

Step 3: If GSoft2 was previously installed, the Change, repair, or remove installation window allows you to effect changes to your installation, repair corrupt files or fix other issues with the current installation. Should you choose, the GSoft2 file can be removed as well.



Step 4: If this is a new installation, click "Install" to continue the installation process. Follow the prompts to complete software installation.

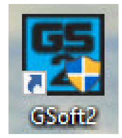


Opening GSoft2 Software Program

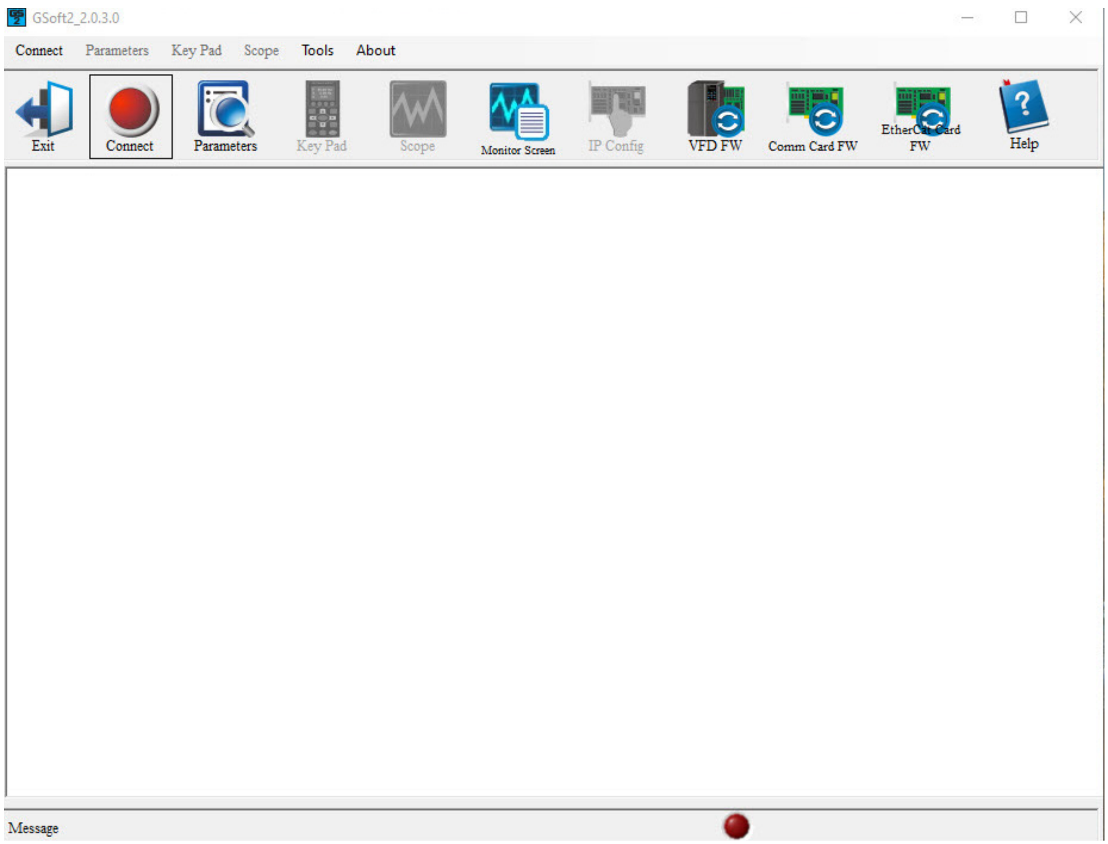
GSoft2 includes an integral help file with software instructions.

GSoft2 offers the user a PC based software configuration tool for creating and editing a GS10 Drive configuration. The configuration tool provides access to GS10 Drive parameters in a table format. Each parameter can be adjusted for your specific drive application. Once the selected parameters have been changed, the file can be downloaded to the GS10 Drive as well as saved to your project folder for future use on other drives. Once created and saved, subsequent editing is done using the GSoft2 software.

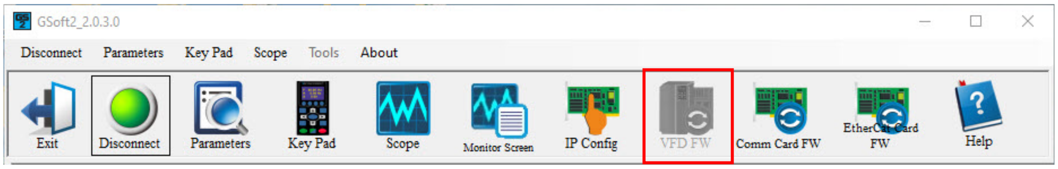
Double click the GSoft2 shortcut to open the program; OR click in the search box in the lower left corner of Desktop and type GSoft2.



GSoft2 Graphic User Interface (GUI) will open. You will notice that only one menu command is in bold (Connect), while the others are grayed out. Some icons on the toolbar are initially grayed out as well. At this point, the GUI includes seven Icons that are available as shown in the screencap. "Connect" is bold as shown upper left.

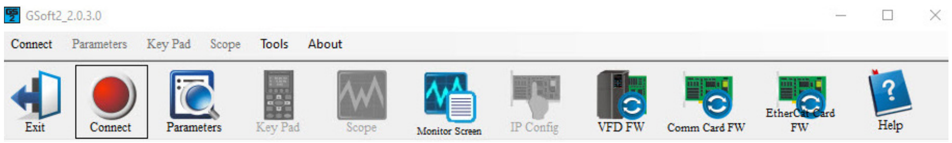


Icons within the red rectangles below will be grayed out after successfully connecting to the drive. Menu Bar commands will now appear in bold text (available).

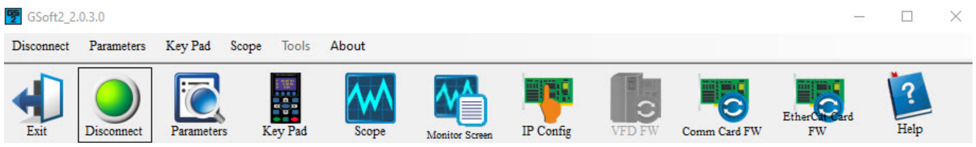


Software Functions

Icon Appearance Before Connecting to Drive



Icon Appearance After Connecting to Drive



Icon Functions

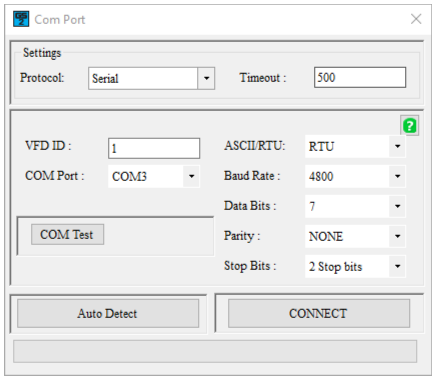
EXIT: Shuts down the GSoft2 software. (A pop-up "Are you sure" window will appear).

CONNECT: Opens Com Port dialog box (Same as “Connect” on the menu bar). This allows you to configure the settings to establish serial communication to your drive. If several COM ports are installed on your PC, you will need to go to Device Manager to determine which COM port is the correct one.
For GS10 connection to Gsoft2, the default communication settings are required:

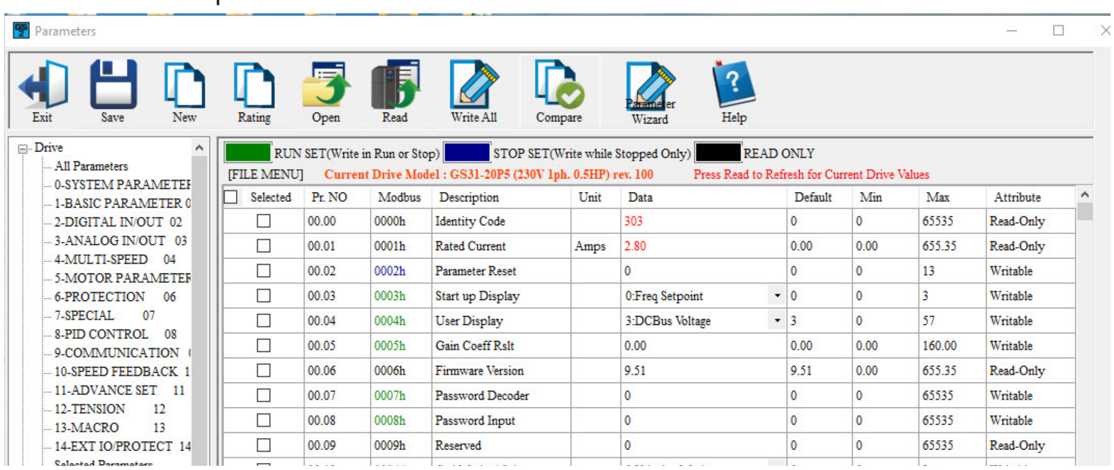
- *P09.01 - Comm Speed = 38.4 Kpbs*
- *P09.04- Comm Protocol = 13 (8,N,2- RTU)*

If the Comm settings are not at default values and "AUTO DETECT" is clicked, GSoft2 will change P09.01 and P09.04 to the default values in order to communicate with the drive. When "DISCONNECT" is clicked after configuration is done, Gsoft2 will change the settings back to the original values. If the software is disconnected from the drive by any other means (disconnected cable, closing the program,etc), P09.01 and P09.04 parameters will stay at default values. They will need to be adjusted manually if necessary.

1) Choose the COM port.
2) Press the "COM Test" to verify the connection (a green "OK" should appear)., If Red Fault appears, then press "Auto Detect".
3) Click "CONNECT" to interface with the drive.



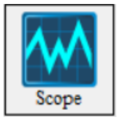
PARAMETERS: Opens GSoft2 drive parameters table. The Parameters screen allows the user to upload and download entire configurations to and from the drive. Individual parameters can be changed "live" as well. There is also the ability to Open and Save files on the PC's hard drive, and the ability to Compare parameter information to a drive's default values. See the online help file for more information.



KEYPAD: Opens an advanced software keypad for use with your drive. Several buttons will be grayed-out (ESC, MENU, and several other keys are non-functional).

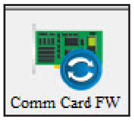
Operational Instructions:

To enable the Jog (F1), RUN, FWD/REV, and STOP/RESET buttons and to allow changes to the drive's speed, please see the GSoft2 online help file (must set P00.20/P00.21 (remote) and P00.30/P00.31 (local) for the drive to accept commands from RS485).



SCOPE: The scope feature is not available on GS10 drives..

IP Config: Allows manual configuration of an optional Ethernet card's IP address. GSoft2 uses the serial USB connection to communicate to the GS10 Drive ethernet communication card. Gsoft2 does not communicate via ethernet.

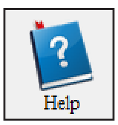


Comm Card FW: Use when upgrading firmware to any newer GS4 Network card with J2 jumper or any GS10 Ethernet comm card. Please read the important *"Firmware Upgrade Notes" on* *page 7–11*. See the GSoft2 Helpfile for details on how to upgrade communication card firmware.

VFD FW: Use when upgrading GS drive firmware. Icon is “grayed out” and not accessible after drive connection has been initiated. Press "Disconnect" to resume functionality. Please read the important *"Firmware Upgrade Notes" on* *page 7–11*. See the GSoft2 Helpfile for details on how to upgrade firmware.

NOTE: 500mA is required from the USB port of the sending PC. If unsure of the available current supplied by the PC, please use a powered USB hub.

EtherCAT Card FW: The GS10 drive does not support use of an EtherCAT card.



Help: Use the icon to show the help file which provides detailed instructions on all features and detailed procedures.

Tools Menu

The following options can be accessed through the Tools menu rather than an icon on the toolbar.

- *GS4 Legacy Comm Card: Access this option through the Tools drop down menu. Use this feature when upgrading the GS4 Legacy ethernet communication cards (no J2 jumper is on the card). Icon is “grayed out” and not accessible after drive connection has been initiated. Press "Disconnect" to resume functionality. This is not used with GS10.*
- *GS4 KEYPAD FW: Use when upgrading KEYPAD firmware. Icon is “grayed out” and not accessible after drive connection has been initiated. Press "Disconnect" to resume functionality.*
  Please read the important "Firmware Upgrade Notes" below.
  See the GSoft2 Helpfile for details on how to upgrade keypad firmware.

Firmware Upgrade Notes

When upgrading firmware, the drive should remain powered ON. Cycle power after upgrade is completed.

All unnecessary USB peripherals should be disconnected from the host PC; only the USB-485M should be connected.

The host PC must be connected to the RJ45 port of the GS10 via the USB-485M (or similar).

Follow the software's instructions to upgrade the GS10 firmware. More detailed firmware upgrade instructions are available in the GSoft2 online help file.

GSoft2 Help File Note

To get the most use out of GSoft2 for the GS10 AC Drive and to learn what powerful features and tools exist within GSoft2, we highly recommend that you use the internally available Help File. There are a couple of ways to access this Help File within the GSoft2 software:

- *Help The easiest way to access the Help File information is to click the Help (Help File) icon in the far right of the Toolbox above the viewing pane.*
- *Alternately, you can access specific topics within the Help File by clicking "?" marks within the GSoft2 software. These links bring up specific Help File information applicable to the particular GSoft2 topic.*

Various data that exists within the User Manual also exists within the Help File, e.g., explanations of "how to" accomplish various tasks. Other information is found only within the Help File, such as more detailed information for using GSoft2 and for upgrading the GS10 drive firmware. The help File also contains detailed information concerning the GS10 AC drive parameters and information for understanding and using the PID process.

Make use of the Help File, and the Help File will live up to its name.

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Accessories

Appendix A

Table of Contents

Fuses/Circuit Breakers

Protection devices are essential to prevent damage to your GS10 drive and application equipment. Please use the fuse specification chart below to select fuses that are applicable to your GS10 drive. Only use UL-certified fuses which comply with your local regulations.

Fuse Specification Chart GS10 *DURAPULSE* Drives

Drive Model	HP	Input Power			Input Fuse			Circuit Breaker	
		Ø	Volts	GS10 Input Amps	Fuse Amps	Fast Acting Class T	Edison Class J*	Size	Note
GS11N-10P2	1/4	1	120	6	7.2	TJN10	JHL10	20	G3P-020
GS11N-10P5	1/2	1	120	9.4	10.8	TJN10	JHL10	25	G3P-025
GS11N-11P0	1	1	120	18	22	TJN25	JHL25	50	G3P-050
GS11N-20P2	1/4	1	230	5.1	7.2	TJN10	JHL10	15	G3P-015
GS11N-20P5	1/2	1	230	7.3	12.8	TJN15	JHL15	20	G3P-020
GS11N-21P0	1	1	230	10.8	20	TJN20	JHL20	30	G3P-030
GS11N-22P0	2	1	230	16.5	34	TJN35	JHL35	45	G3P-045
GS11N-23P0	3	1	230	24.2	50	TJN50	JHL50	70	G3P-070
GS13N-20P2	1/4	3	230	1.9	7.2	TJN10	JHL10	15	G3P-015
GS13N-20P5	1/2	3	230	3.4	12.8	TJN15	JHL15	15	G3P-015
GS13N-21P0	1	3	230	5.8	20	TJN20	JHL20	15	G3P-015
GS13N-22P0	2	3	230	9	32	TJN35	JHL35	25	G3P-025
GS13N-23P0	3	3	230	13.2	50	TJN50	JHL50	40	G3P-040
GS13N-25P0	5	3	230	20	78	TJN80	JHL80	60	G3P-060
GS13N-27P5	7 1/2	3	230	30	59.4	TJN60	JHL60	63	G3P-060
GS13N-40P5	1/2	3	460	2.1	7.2	TJS10	JHL10	15	G3P-015
GS13N-41P0	1	3	460	3.7	12	TJS15	JHL15	15	G3P-015
GS13N-42P0	2	3	460	5.8	18.4	TJS20	JHL20	15	G3P-015
GS13N-43P0	3	3	460	6.1	26	TJS25	JHL25	20	G3P-020
GS13N-45P0	5	3	460	9.9	42	TJS45	JHL45	30	G3P-030
GS13N-47P5	7 1/2	3	460	14.3	34.5	TJS35	JHL35	32	G3P-030
GS13N-4010	10	3	460	19.3	45.1	TJS45	JHL45	45	G3P-040

** High-speed Class J.*
Note: JHL fuses can be used with GS and DURAPULSE drives in non-UL applications. Fuse the drive according to NEC guidelines (NEC Article 430). For UL applications DURAPULSE drives require Class T fuses (refer to the drive's user manual for details).

Recommended Fuse Specifications for the DC-side of Common DC-Bus

These fuses are applicable only when connecting input power directly to the DC bus with terminals DC+ and DC-.

- *The fuse current specifications in table below are based on overloading. If there is no possibility of overloading during use then fuses with a lower rating than the table below are allowed. The DC-side current calculation method described in Chapter 3.1 DC Power Supply Applications can be used to calculate a suitable fuse rating for a drive with DC current. Special cases such as overload or emergency stop must be considered however.*
- *For the DC-side fuse, please select a DC fuse or refer to the DC voltage specifications from the fuse parameters. The DC voltage rating must be higher than the operating voltage.*
- *Fuse selection should take into account operating class (e.g. High-speed or general purpose) and overloading.*
  a) If the drive is subject to overloading and high-speed fuse is used: Due to the speed of response the chosen fuse should be rated double that of the calculated maximum instantaneous DC current.
  b) If the drive is subject to overloading and normal fuse is used: Fuse selection should be based on the calculated maximum instantaneous current during overloading.
  c) If drive is not subject to overloading: Select a fuse with a current rating close to that of the calculated DC current.
- *UL-listed fuse suitable for short-circuit protection of inputs. "In the United States, branch circuits must comply with the US National Electrical Code (NEC) and its local directives." Please select a UL-listed fuse to comply with local regulations.*
- *"In Canada, branch circuits must comply with the Canadian Electrical Code and its local directives." Please select a UL-listed fuse to comply with local regulations.*

GS10 - DC Bus Fusing			
Requirement	***Drive Model***	***230V Drives***	***460V Drives***
DC Bus Voltage Level	all models	350	700
DC Bus Fuse Voltage Rating	all models	690	1250
DC Bus Fuse (amps)	1P2 (1/4HP)	10	n/a
	1P5 (1/2HP)	10	10
	1P0 (1HP)	16	10
	2P0 (2HP)	25	16
	3P0 (3HP)	40	20
	5P0 (5HP)	63	30
	7P5 (7.5HP)	80	40
	010 (10HP)	n/a	55

Standard Footprint EMC Filter and Zero Phase Reactor

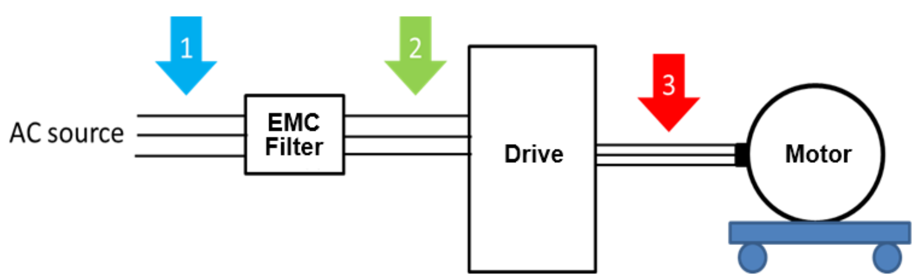
Use EMC filters to enhance the EMC performance for the environment and machines and to comply with EMC regulations, further reducing EMC problems. If you purchase a motor drive without a built-in EMC filter, we recommend that you select an EMC filter as shown below. GS10 drives will mount on top of these footprint filters for Frames A–D. For some motor drive models, you need to use zero phase reactors to be compliant with EMC regulations. Refer to the table and figure below for the recommended model, setting method, and maximum motor cable length of the EMC filter and zero phase reactor.

GS10 EMC Filter and Zero Phase Reactor

Frame	*Drive Model*	*Input Current (A)*	*Footprint Filter Model #*	*Recommended Zero Phase Reactor*	*Conducted Emission*				*Radiated Emission*		
					C1-motor cable length-30m			C2-motor cable length-100m	C2-motor cable length-100m		
					Position to Install a Zero Phase Reactor						
					1	*2*	*3*	*n/a*	*1*	*2*	*3*
A	***GS11N-10P2***	6	EMF11AM21A	RF008X00A				N/A			
	GS11N-10P5	9.4						N/A			
	GS11N-20P2	5.1				✓	✓	N/A		✓	✓
	GS11N-20P5	7.3				✓	✓	N/A		✓	✓
	GS13N-20P2	1.9	EMF10AM23A			✓	✓	N/A		✓	✓
	GS13N-20P5	3.4				✓	✓	N/A		✓	✓
	GS13N-21P0	5.8				✓	✓	N/A		✓	✓
	GS13N-40P5	2.1	EMF6A0M43A				✓	N/A			✓
	GS13N-41P0	3.7					✓	N/A			✓
B	***GS11N-21P0***	10.8	EMF11AM21A			✓	✓	N/A		✓	✓
	GS13N-22P0	9	EMF10AM23A			✓	✓	N/A		✓	✓
	GS13N-42P0	5.8	EMF6A0M43A				✓	N/A			✓
C	***GS11N-11P0***	18	EMF27AM21B					N/A			
	GS11N-22P0	16.5					✓	N/A			✓
	GS11N-23P0	24.2					✓	N/A			✓
	GS13N-23P0	13.2	EMF24AM23B			✓	✓	N/A		✓	✓
	GS13N-25P0	20				✓	✓	N/A		✓	✓
	GS13N-43P0	6.1	EMF12AM43B					N/A			
	GS13N-45P0	9.9				✓	✓	N/A		✓	✓
D	***GS13N-27P5***	30	EMF33AM23B		✓	✓		N/A	✓	✓	
	GS13N-47P5	14.3	EMF23AM43B		✓	✓	✓	N/A	✓	✓	✓
	GS13N-4010	19.3			✓	✓	✓	N/A	✓	✓	✓

Note: It is not necessary to add a zero phase reactor for passing the C2 conducted emission test.
**** See diagram below for installation positions.*

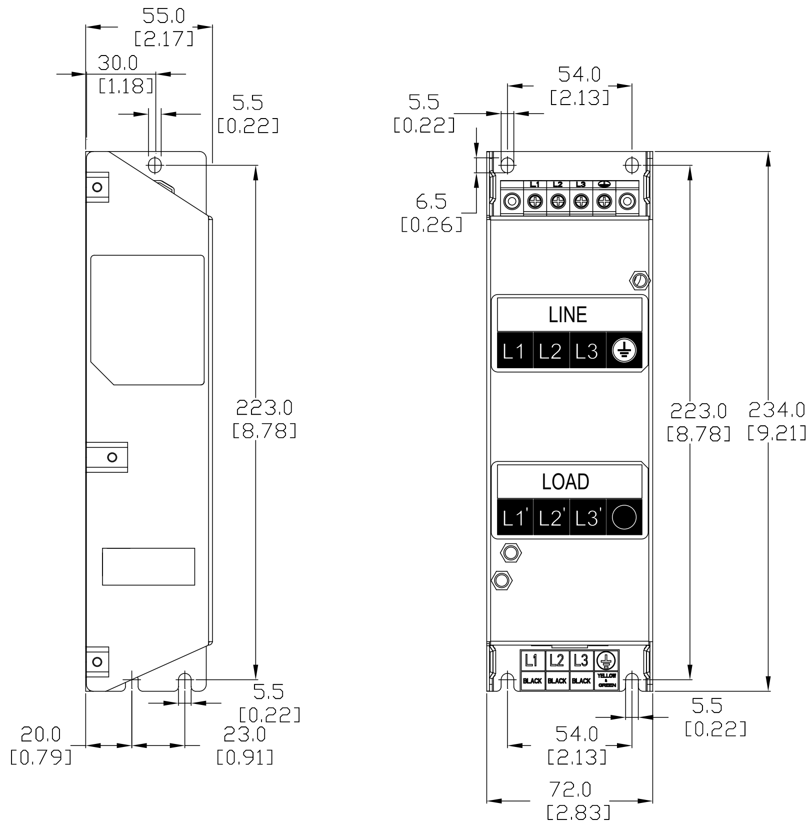
Zero phase reactor installation position diagram:



1: Install at the cable between the power supply and the EMC filter.
2: Install at the cable between the EMC filter and the drive.
3: Install at the cable between the drive and the motor.

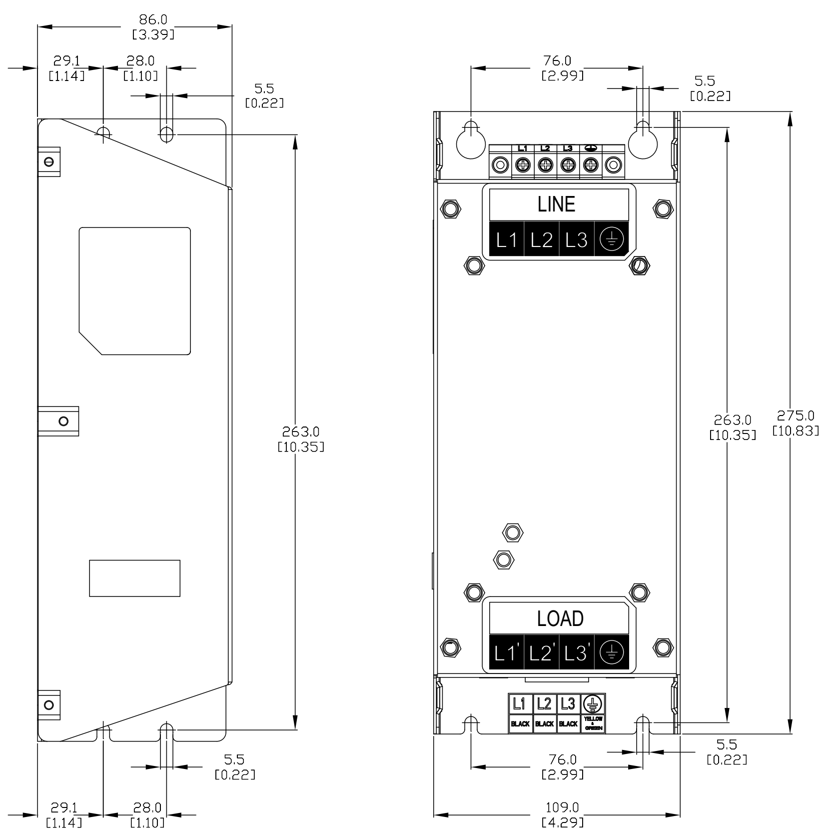
Filter Dimensions

EMF11AM21A
EMF10AM23A
EMF6A0M43A



Screw	Torque
M5 x 2	16–20 kg-cm / 13.9–17.3 lb-in / 1.56–1.96 N•m
M4 x 2	14–16 kg-cm / 12.2–13.8 lb-in. / 1.38–1.56 N•m

EMF27AM21B; EMF24AM23B
EMF33AM23B; EMF12AM43B
EMF23AM43B



Screw	Torque
M5 x 4	16–20 kg-cm / 13.9–17.3 lb-in. / 1.56–1.96 N•m

High Performance EMI Input Filters

The optional accessories listed in this chapter are available for use with the GS10 drive. Selection of these accessories is application specific and may improve drive performance. Additional information regarding filter installation and operation is available in the AutomationDirect white paper, "Applied EMI/RFI Techniques Overview."

EMI Filters Selection			
Model	**Description**	**EMI Filter***	
		Roxburgh Filters Chassis 1ph	**Roxburgh Filters C2 Rated**
GS11N-10P2	120V 1ph, 1/4 HP	**RES90F10**	**MIF10**
GS11N-10P5	120V 1ph, 1/2 HP	**RES90F16**	**MIF16**
GS11N-11P0	120V 1ph, 1 HP	**RES90S30**	**MIF23**
GS11N-20P2	230V 1ph, 1/4 HP	**RES90F06**	**MIF06**
GS11N-20P5	230V 1ph, 1/2 HP	**RES90F10**	**MIF10**
GS11N-21P0	230V 1ph, 1 HP	**RES90F16**	**MIF16**
GS11N-22P0	230V 1ph, 2 HP	**RES90S20**	**MIF23**
GS11N-23P0	230V 1ph, 3 HP	**RES90S30**	**MIF330B**
GS13N-20P2	230V 3ph, 1/4 HP	*n/a*	**KMF306A**
GS13N-20P5	230V 3ph, 1/2 HP		**KMF306A**
GS13N-21P0	230V 3ph, 1 HP		**KMF306A**
GS13N-22P0	230V 3ph, 2 HP		**KMF318A**
GS13N-23P0	230V 3ph, 3 HP		**KMF318A**
GS13N-25P0	230V 3ph, 5 HP		**KMF325A**
GS13N-27P5	230V 3ph, 7.5 HP		**KMF336A**
GS13N-40P5	460V 3ph, 1/2 HP		**KMF306A**
GS13N-41P0	460V 3ph, 1 HP		**KMF306A**
GS13N-42P0	460V 3ph, 2 HP		**KMF306A**
GS13N-43P0	460V 3ph, 3 HP		**KMF310A**
GS13N-45P0	460V 3ph, 5 HP		**KMF318A**
GS13N-47P5	460V 3ph, 7.5 HP		**KMF318A**
GS13N-4010	460V 3ph, 10 HP		**KMF325A**
** All specs for the EMI filters can be found at www.automationdirect.com or by clicking the following links: -KMF Series Filters -MIF Series Filters -RES90 Series Filters*			

EMI Filter Installation

Electrical equipment like the GS10 drive, will generate electrical noise when in operation and may interfere with the normal operation of peripheral equipment. The use of an EMI filter will mitigate this type of power supply interference. Other measures may be required for reduction or mitigation of radiated emissions. Roxburgh EMI filters have been tested with the GS10 family of drives and are recommended for the mitigation of interference and the highest performance When the GS10 drive and Roxburgh EMI filter are installed and wired according to the user manual, the installation will conform to the following rules:

- *EN61000-6-4*
- *EN61800-3: 1996*
- *EN55011 (1991) Class A Group 1 (1st Environment, restricted distribution)*

General precaution

1) *Install the EMI filter and GS10 drive on the same subpanel or metal plate.*
2) *Install the EMI filter as close as possible to the GS10 drive.*
3) *Keep wiring between the EMI filter and GS10 drive as short as possible.*
4) *The subpanel or metal plate used to support the EMI filter and GS10 drive should be well grounded (minimal resistance to ground is typically less then 1Ω).*

5) *To insure that the EMI filter and GS10 drive are adequately grounded, insure that both are securely attached to the subpanel or plate.*

Choose suitable motor cable and precautions

Proper installation and the the choice of good motor cable will positively affect the performance of the filter. When selecting motor cable, please observe the following precautions.

1) *Cable shielding (double shielding is best).*
2) *Ground the shield on both ends of the motor cable. Maintain minimum length and employ strong mechanical connection to ground.*
3) *Remove paint on the metal saddle, subpanel or plate to insure good contact to ground.*

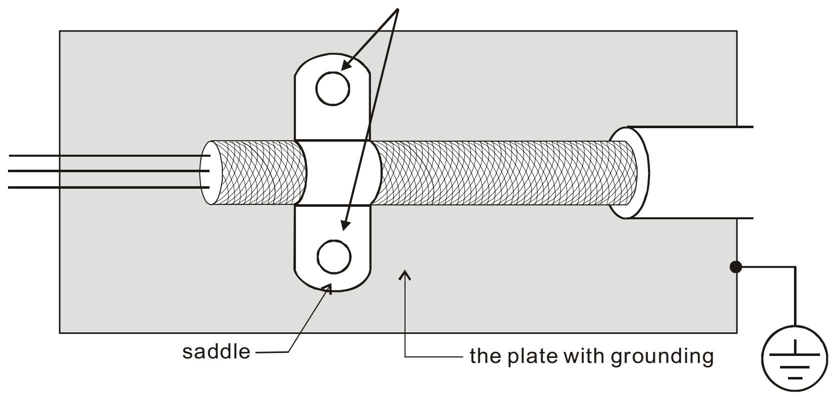


Figure 1

EMI Filter Installation (continued)

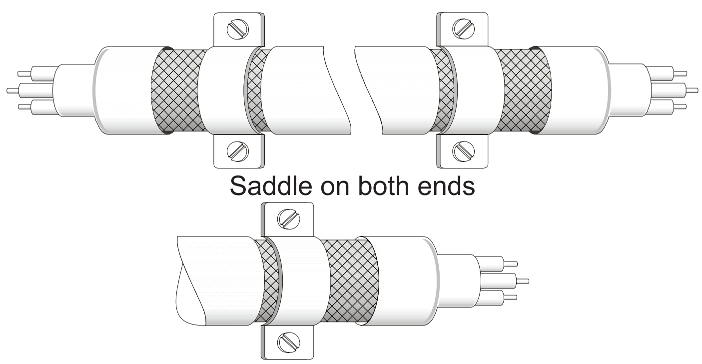


Figure 2

Reflective Wave Phenomenon

The inverter section of a PWM drive like the GS10 does not produce sinusoidal output voltage wave forms. Rather, the output voltage produced is a continuous train of width modulated pulses, sent to the motor terminals via the motor cable.

Peak pulse voltage at the GS10 drive is equal to the drive DC bus voltage and contains steep rise and fall times, the result of the IGBT switching device used in the drive inverter section.

Peak pulse voltage at the motor terminals may exceed the drive DC bus voltage and is dependent on the dynamics of the drive output voltage rise time, cable transmission line characteristics, cable length and motor impedance.

The voltage pulse train at the motor terminals experiences momentary transient over voltage as the IGBT transistors switch. The result being voltage levels at the motor terminals double that of the drive bus voltage.

Over voltage of this type has the potential to stress the motor insulation, damaging the motor.

Recommended Motor Cable Length

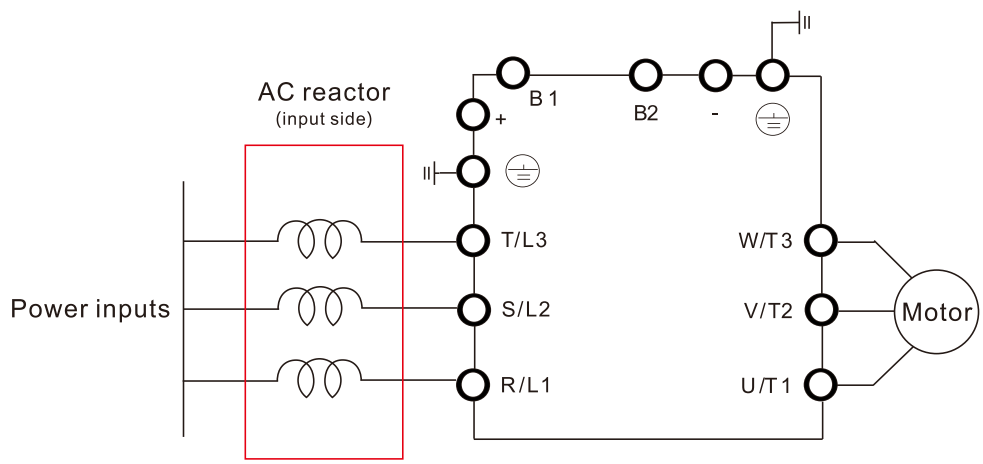
1) Never connect phase lead capacitors or surge absorbers to the output terminals of the drive.
2) As cable length increases, capacitance between cables will increase and may result in leakage current and over current faults with the possibility of damage to the GS10 drive.
3) If more than one motor is connected to the drive, the total cable length is the sum of the cable lengths from the GS10 drive to each motor.
4) Should an overload relay malfunction occur, lower the GS10 drive carrier frequency (P2.10) or install an output reactor.
5) When operating an AC motor with a PWM drive like the GS10, the motor may experience reflective wave as described above. To prevent this situation, please observe the recommendations below:
   a) Use a motor with enhanced insulation. (1000V, 1200V, 1600V, higher is better)
   b) Connect an output reactor (optional) to the output terminals of the drive.
   c) Keep motor cable length as short as possible. (65ft, 20m, or less)
   d) Where motor cable lengths will exceed 65ft (20m), refer to "Maximum Recommended Cable Length - GS10" on page A–15.

Line Reactors / Voltage Time Filters

Line Reactor

Installing an AC reactor on the input side of an AC motor drive can increase line impedance, improve the power factor, reduce input current, increase system capacity, and reduce interference generated from the motor drive. It also reduces momentary voltage surges or abnormal current spikes from the mains power, further protecting the drive. For example, when the main power capacity is higher than 500 kVA, or when using a phase-compensation capacitor, momentary voltage and current spikes may damage the AC motor drive's internal circuit. An AC reactor on the input side of the AC motor drive protects it by suppressing surges.

Install an AC input reactor in series between the main power and the three input phases R S T, as shown in the figure below:

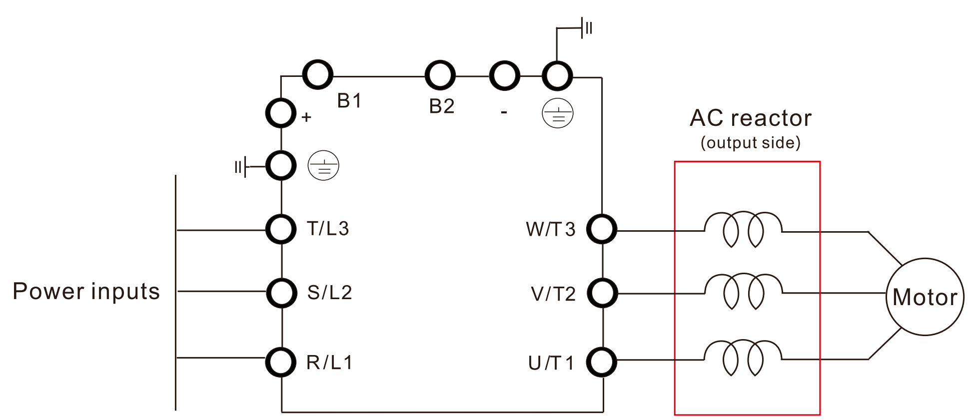


Load Reactor/Voltage Time Filter

When using drives in long wiring output application, ground fault (GFF), over-current (OC) and motor over-voltage (OV) often occur. GFF and OC cause errors due to the drive's self-protective mechanism; over-voltage damages motor insulation.

The excessive length of the output wires makes the grounded stray capacitance too large, increases the three-phase output common mode current, and the reflected wave of the long wires makes the motor dv / dt and the motor terminal voltage too high. Thus, installing a reactor on the drive's output side can increase the high-frequency impedance to reduce the dv / dt and terminal voltage to protect the motor. For distances greater than 100 feet, a dV/dT filter (VTF Series) is recommended for best performance.

Install an AC output reactor or voltage time filter in series between the three output phases U V W and the motor, as shown in the figure below:

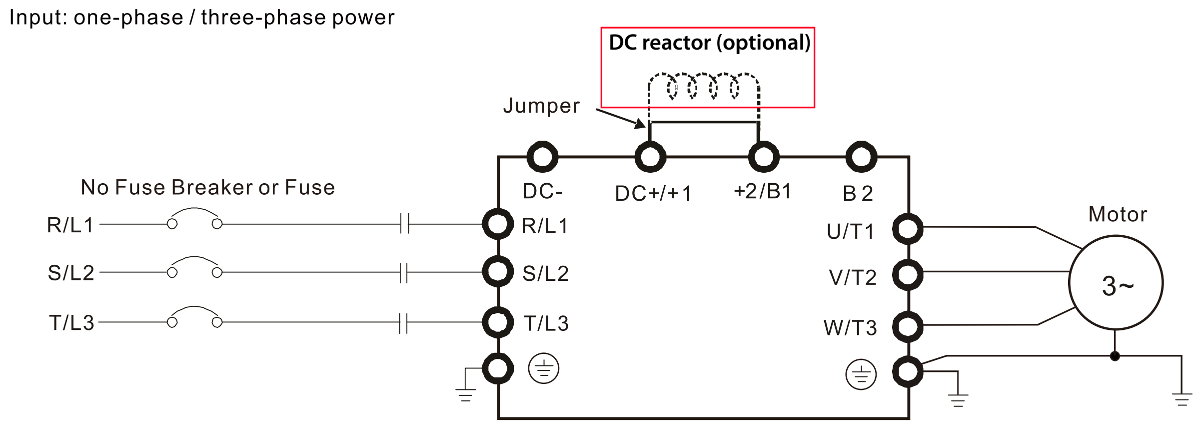


DC Reactor

A DC reactor can also increase line impedance, improve the power factor, reduce input current, increase system power, and reduce interference generated from the motor drive. A DC reactor stabilizes the DC bus voltage. Compared with an AC input reactor, a DC reactor is in smaller size, lower price, and lower voltage drop (lower power dissipation).

Install a DC reactor between terminals +1 and +2. Remove the jumper, as shown in the figure below, before installing a DC reactor.

Note: 120V models have no DC reactor/choke terminals.



When the GS10 drive is connected directly to a large-capacity power transformer (600kVA or above) or when a power correction capacitor is switched on, excessive peak currents may occur in the input power circuit resulting in damage to the GS10 drive.

To avoid this, install a line reactor in series with the GS10 drive on the input side. The installation of a line reactor will reduce input current peaks and improve the output power efficiency.

Line (load) reactors installed on the output side protect the motor insulation against AC drive short circuits and IGBT reflective wave damage, and also allow the motor to run cooler by "smoothing" the motor current waveform. They are recommended for operating "non-inverter-duty" motors, and for any motors where the length of wiring between the AC drive and motor is less than or equal to 100 feet. For AC drive-to-motor wiring distances over 100 feet, use of the VTF series output filter is recommended.

Line/Load Reactors Selection Charts

GS10 Line/Load Reactor, AC Output Filter, & DC Reactor Selections							
GS10 Model	**CT Output Amps (rms)**	**Saturation Amps (rms)**	**Motor HP**	**Line Reactor (Drive Input) (LR2)****	**Load Reactor (Drive Output) (LR2)****	**AC Output Filter (VTF)****	**DC Reactor Delta P/N***
GS11N-10P2	1.6	3.2	0.25	LR2-10P2-1PH	LR2-20P2	VTF-46-DE	DR005L0254
GS11N-10P5	2.5	5	0.5	LR2-10P5-1PH	LR2-20P5	VTF-246-CFG	
GS11N-11P0	4.8	9.6	1.0	LR2-11P5-1PH	LR2-21P0	VTF-24-FH	
GS11N-20P2	1.6	3.2	0.25	LR2-20P5-1PH	LR2-20P2	VTF-46-DE	
GS11N-20P5	2.8	5.6	0.5	LR2-20P5-1PH	LR2-20P5	VTF-246-CFG	
GS11N-21P0	4.8	9.6	1.0	LR2-21P5-1PH	LR2-21P0	VTF-24-FH	
GS11N-22P0	7.5	15	2.0	LR2-22P0-1PH	LR2-22P0	VTF-246-HKL	DR008L0159
GS11N-23P0	11	22	3.0	LR-27P5	LR-25P0	VTF-24-JL	DR011L0115
GS13N-20P2	1.6	3.2	0.25	LR2-20P2	LR2-20P2	VTF-46-DE	DR005D0585
GS13N-20P5	2.8	5.6	0.5	LR2-20P5	LR2-20P5	VTF-246-DGH	
GS13N-21P0	4.8	9.6	1.0	LR2-20P7	LR2-20P7	VTF-24-FH	
GS13N-22P0	7.5	15	2.0	LR2-22P0	LR2-22P0	VTF-246-HKL	DR008D0366
GS13N-23P0	11	22	3.0	LR-25P0	LR-23P0	VTF-24-JL	DR011D0266
GS13N-25P0	17	34	5.0	LR-27P5	LR-25P0	VTF-46-LM	DR017D0172
GS13N-27P5	25	50	7.5	LR-2010	LR-27P5	VTF-46-NP	DR025D0117
GS13N-40P5	1.5	3	0.5	LR2-40P5	LR2-40P5	VTF-46-DE	DR003D1870
GS13N-41P0	2.7	5.4	1.0	LR2-42P0	LR2-41P0	VTF-246-CFG	
GS13N-42P0	4.2	8.4	2.0	LR2-45P0	LR2-42P0	VTF-24-FH	DR004D1403
GS13N-43P0	5.5	11	3.0	LR2-45P0	LR2-43P0	VTF-24-FH	DR006D0935
GS13N-45P0	9	18	5.0	LR2-47P5	LR2-45P0	VTF-246-HKL	DR009D0623
GS13N-47P5	13	26	7.5	LR-4010	LR2-47P5	VTF-24-JL	DR012D0467
GS13N-4010	17.5	34	10.0	LR-4015	LR-4010	VTF-24-JL	DR018D0311

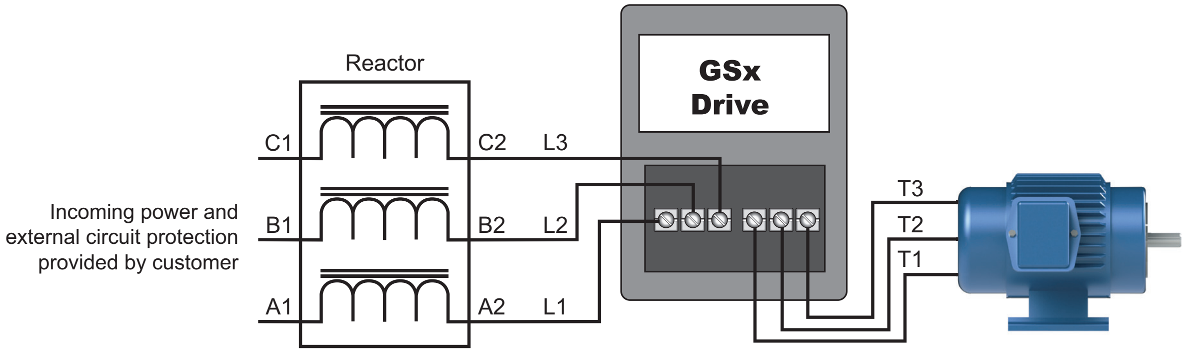
** Not available at AutomationDirect.com*
*** Reactor sizing is based on rated HP NEMA motor load, not drive output amp load. Size the reactor based on the motor nameplate current. All specs for the LR2 and VTF can be found at www.automationdirect.com or by clicking the following links:*

-*LR2 Line Reactors*
-*VTF Output Filters*

Line Reactor Applications and Wiring Connections

Input Side of AC Drive

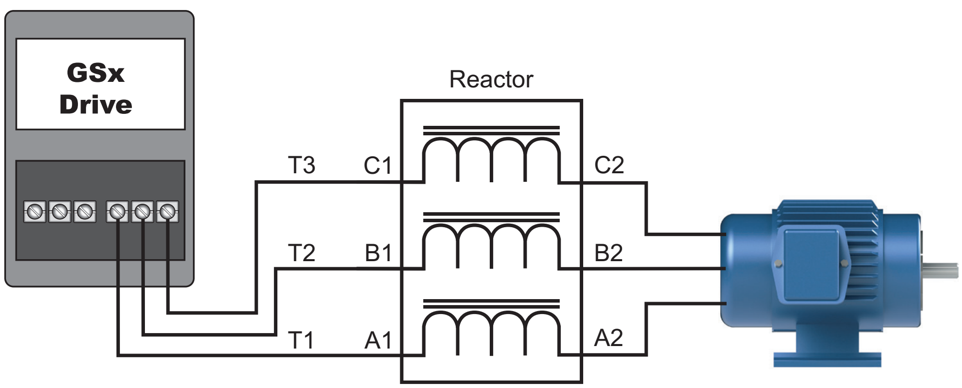
When installed on the input side of the GS10 drive, a line reactor will reduce line notching, current peaks, voltage spikes and surges from the incoming line, as well as reduce the available short circuit current. A line reactor will also reduce harmonic distortion from the GS10 drive onto the line. The line reactor is installed in front of the GS10 drive as shown.



Please refer to "Chapter 2: Installation and Wiring" for detailed wiring information for the GS10 drive.

Output Side of AC Drive

When installed on the output side of the GS10 drive, line (load) reactors help to protect the GS10 drive from short circuits at the load. Voltage and current waveforms from the GS10 drive are enhanced, reducing motor overheating and noise emissions.

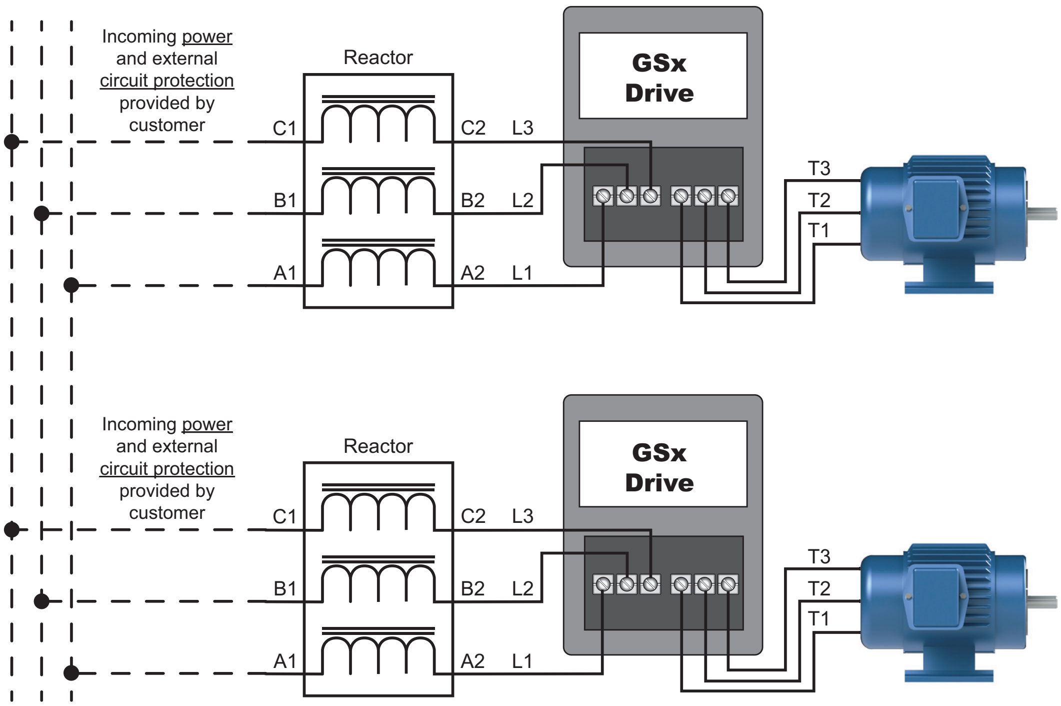


Please refer to "Chapter 2: Installation and Wiring" for detailed wiring information for the GS10 drive.

Single phase line reactors should NOT be installed on the output side of an AC Drive. Use only three-phase reactors on drive outputs, and only for three-phase motors.

Multiple AC Drives

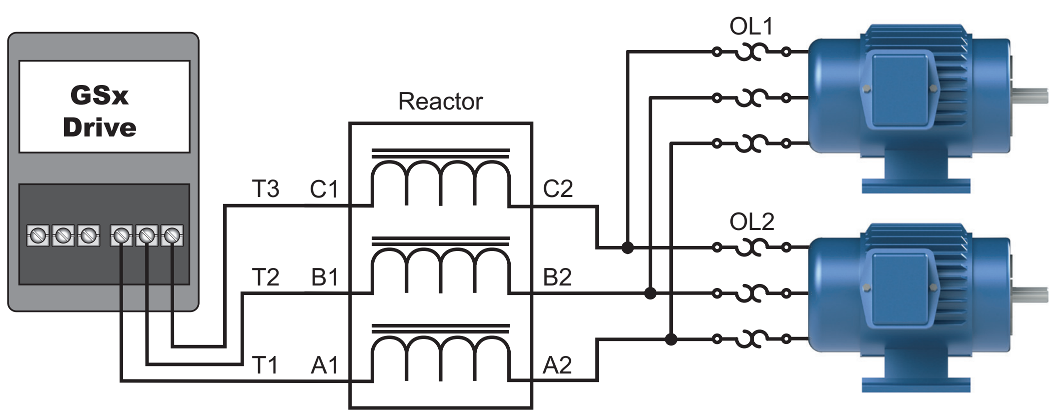
Individual line reactors are recommended when installing multiple GS10 drives on the same power line. Individual line reactors eliminate cross-talk between multiple GS10 drives and provide isolated protection for each GS10 drive for its own specific load.



Please refer to "Chapter 2: Installation and Wiring" for detailed wiring information for the GS10 drive.

Multiple Motors

A single output (load) reactor can be used with multiple motors on the same GS10 drive, but only if the motors operate simultaneously. Size the reactor based upon the total horsepower of all the motors, and select a reactor with a current rating greater than the sum of the motor full-load currents. Overload relays are required for use in multi-motor applications.

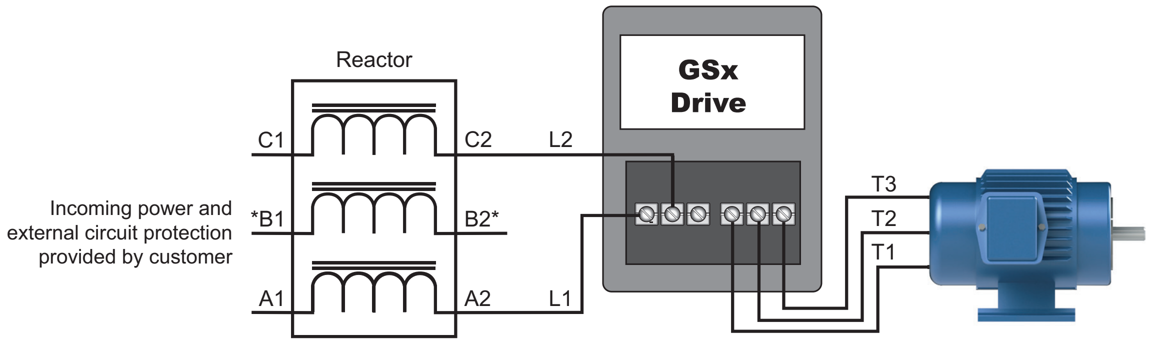


Please refer to "Chapter 2: Installation and Wiring" for detailed wiring information for the GS10 drive.

A single reactor should be used with multiple motors ONLY when the motors will operate simultaneously from a single AC drive. OVERLOAD RELAYS are required for use in multiple motor applications.

Single-Phase Applications

Some three-phase line reactors are listed for use with single-phase input power. Follow the connection diagram shown below. Make sure that terminals B1 and B2, if present, are properly insulated before any connections are made. If a 3-phase reactor is used on the line side of a single-phase input drive application, ensure that the actual single-phase current does not exceed the Line Reactor's current rating (example: a 3-phase, 5hp Line Reactor and 3-phase 5hp drive will not handle enough current to power a 5hp motor on a single-phase supply - both the drive and the Line Reactor will have to be upsized).



*LR series 1-phase reactors do not include a B-phase winding.

Please refer to "Chapter 2: Installation and Wiring" for detailed wiring information for the GS10 drive.

Ensure that you properly insulate terminals B1 and B2 before making any connections to single-phase power.

Recommended Cable Length

Motor Leakage Current

If the cable length is too long, the stray capacitance between cables increases and may cause leakage current. This activates over-current protection, increases leakage current, or may affect the current display. In the worst case, it may damage the AC motor drive. If more than one motor is connected to one AC motor drive, the total wiring length should be the sum of the wiring length from AC motor drive to each motor.

For the 460V series AC motor drive, when you install an overload thermal relay between the drive and the motor to protect the motor from overheating, the connecting cable must be shorter than 50m; however, an overload thermal relay malfunction may still occur. To prevent the malfunction, install an output reactor (optional) to the drive or lower the carrier frequency setting (see P00.17 Carrier Frequency).

Motor Surge Voltage

When a motor is driven by a PWM-type AC drive, the motor terminals experience surge voltages (dv/dt) due to power transistor conversion of the drive. For very long motor cable (especially for the 460V series), surge voltages (dv/dt) may damage the motor insulation and bearing. To prevent this, follow these rules:

A) Use a motor with enhanced insulation.
B) Reduce the cable length between the AC drive and motor to suggested values.
C) Connect an output reactor (optional) to the output terminals of the AC drive.

Refer to the following tables for the suggested motor shielded cable length. For drive models < 480V, use a motor with a rated voltage ≤ 500 VAC and an insulation level ≥ 1.35 kVp-p in accordance with IEC 60034-17.

<table>
<tr><th colspan="8">Maximum Recommended Cable Length - GS10</th></tr>
<tr><th rowspan="2">GS10 Model</th><th colspan="2">Input Power</th><th rowspan="2">VT Rated Current (Arms)</th><th colspan="2">Without Output AC Reactor (meters)</th><th colspan="2">With Output AC Reactor (meters)</th></tr>
<tr><th>Ø</th><th>Volts</th><th>Shielded Cable</th><th>Unshielded Cable</th><th>Shielded Cable</th><th>Unshielded Cable</th></tr>
<tr><td>GS11N-10P2</td><td rowspan="8">1</td><td rowspan="3">120</td><td>1.8</td><td rowspan="15">50</td><td rowspan="15">75</td><td rowspan="15">75</td><td rowspan="15">115</td></tr>
<tr><td>GS11N-10P5</td><td>2.7</td></tr>
<tr><td>GS11N-11P0</td><td>5.5</td></tr>
<tr><td>GS11N-20P2</td><td rowspan="5">230</td><td>1.8</td></tr>
<tr><td>GS11N-20P5</td><td>3.2</td></tr>
<tr><td>GS11N-21P0</td><td>5</td></tr>
<tr><td>GS11N-22P0</td><td>8.5</td></tr>
<tr><td>GS11N-23P0</td><td>12.5</td></tr>
<tr><td>GS13N-20P2</td><td rowspan="14">3</td><td rowspan="7">230</td><td>1.8</td></tr>
<tr><td>GS13N-20P5</td><td>3.2</td></tr>
<tr><td>GS13N-21P0</td><td>5</td></tr>
<tr><td>GS13N-22P0</td><td>8</td></tr>
<tr><td>GS13N-23P0</td><td>12.5</td></tr>
<tr><td>GS13N-25P0</td><td>19.5</td></tr>
<tr><td>GS13N-27P5</td><td>27</td></tr>
<tr><td>GS13N-40P5</td><td rowspan="7">460</td><td>1.8</td><td rowspan="3">35</td><td rowspan="3">50</td><td rowspan="3">50</td><td rowspan="3">90</td></tr>
<tr><td>GS13N-41P0</td><td>3</td></tr>
<tr><td>GS13N-42P0</td><td>4.6</td></tr>
<tr><td>GS13N-43P0</td><td>6.5</td><td rowspan="3">50</td><td rowspan="3">75</td><td rowspan="3">75</td><td rowspan="3">115</td></tr>
<tr><td>GS13N-45P0</td><td>10.5</td></tr>
<tr><td>GS13N-47P5</td><td>15.7</td></tr>
<tr><td>GS13N-4010</td><td>20.5</td><td>100</td><td>150</td><td>150</td><td>225</td></tr>
</table>

Dynamic Braking

Dynamic braking resistors dissipate the regeneration energy of AC motors when they are being controlled to a stop faster than a coasting stop. All GS10 drives have the braking function circuitry built-in and do not require a separate dynamic braking unit.

To utilize dynamic braking:

1) Wire the appropriate braking resistor to terminals B1/B2 (refer to page 2–15).
2) Set parameter P07.00 Software Brake Chopper Action Level for the application. When the DC bus voltage rises above this setpoint, the dynamic braking circuit will activate.

To avoid possible injury, please refer to Chapter 2 of this manual for correct wiring of the braking resistors.

Drive Unit Dynamic Braking Specifications

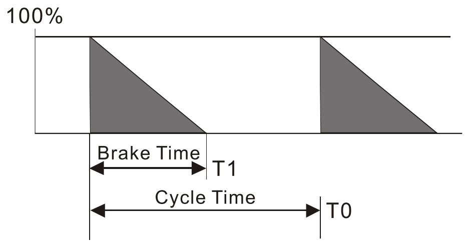
GS10 AC Drive Dynamic Braking Specifications							
Drive Voltage	Motor Power		Drive Model	Drive Braking Circuit B1/B2			Compatible Brake Resistors* (125% Torque, 10% Duty Cycle)
	(hp)	(kW)		Min Resistor Value (Ω)	Max Total Brake Current (A)	Peak Power (kW)	
120V	1/4	0.2	**GS11N-10P2**	190.0	2	0.8	Click here
	1/2	0.4	**GS11N-10P5**	95.0	4	1.5	
	1	0.75	**GS11N-11P0**	63.3	6	2.3	
230V	1/4	0.2	**GS11N-20P2**	190.0	2	0.8	
	1/2	0.4	**GS11N-20P5**	95.0	4	1.5	
	1	0.75	**GS11N-21P0**	63.3	6	2.3	
	2	1.5	**GS11N-22P0**	47.5	8	3.0	
	3	2.2	**GS11N-23P0**	38.0	10	3.8	
	1/4	0.2	**GS13N-20P2**	190.0	2	0.8	
	1/2	0.4	**GS13N-20P5**	95.0	4	1.5	
	1	0.75	**GS13N-21P0**	63.3	6	2.3	
	2	1.5	**GS13N-22P0**	47.5	8	3.0	
	3	2.2	**GS13N-23P0**	38.0	10	3.8	
	5	3.7	**GS13N-25P0**	19.0	20	7.6	
	7 1/2	5.5	**GS13N-27P5**	16.5	23	8.7	
460V	1/2	0.4	**GS13N-40P5**	380.0	2	1.5	
	1	0.75	**GS13N-41P0**	190.0	4	3.0	
	2	1.5	**GS13N-42P0**	126.7	6	4.6	
	3	2.2	**GS13N-43P0**	108.6	7	5.3	
	5	3.7	**GS13N-45P0**	84.4	9	6.8	
	7.5	5.5	**GS13N-47P5**	50.7	15	11.4	
	10	7.5	**GS13N-4010**	40.0	19	14.4	

** 10% Duty Cycle with maximum ON (braking) time for 10 seconds.*

For a full list of all brake resistors compatible with GS10 drives, please see the GS10 series braking technical specification: https://cdn.automationdirect.com/static/specs/gs10braking.pdf

Choosing and Installing a Braking Resistor

1) Select the resistance value, power and brake usage (ED %).
Definition for Brake Usage ED%:



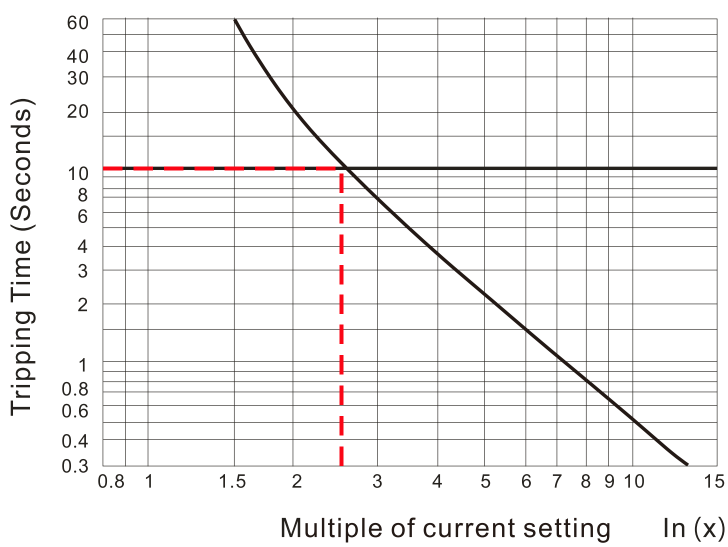
ED% = T1 / T0 x 100(%)

Explanation:
Brake usage ED (%) is the amount of time needed for the brake unit and brake resistor to dissipate heat generated by braking. When the brake resistor heats up, the resistance increases with temperature, and braking torque decreases accordingly.

For safety, install a thermal overload relay (O.L) between the brake unit and the brake resistor in conjunction with the magnetic contactor (MC) before the drive for additional protection. The thermal overload relay protects the brake resistor from damage due to frequent or continuous braking. Under such circumstances, turn off the power to prevent damage to the brake resistor and drive.

Note: Never use the thermal overload relay to disconnect the brake resistor.

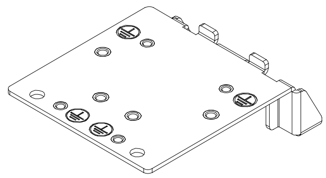
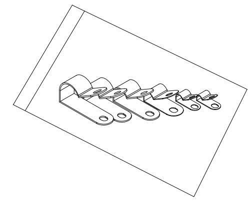
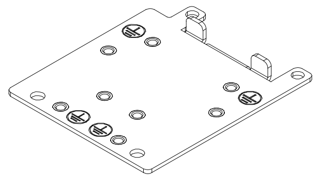
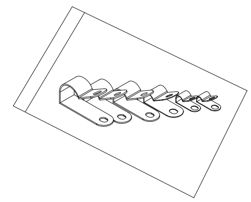
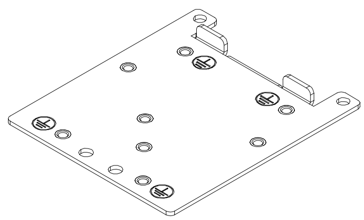
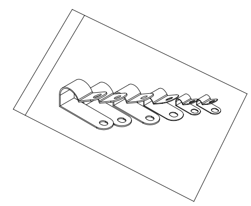
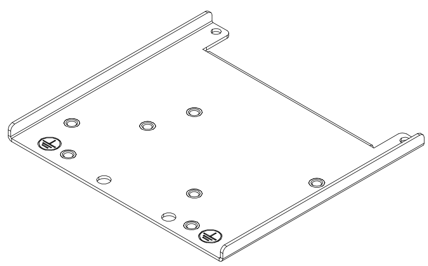
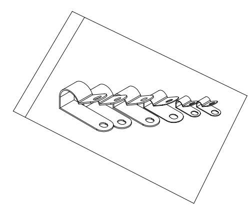
2) Any damage to the drive or other equipment caused by using brake resistors and brake modules that are not provided by AutomationDirect voids the warranty.
3) Consider environmental safety factors when installing the brake resistors. If you use the minimum resistance value, consult AutomationDirect tech support for the power calculation.
4) Refer to the ADC Dynamic Braking unit User Manual for more detail on braking resistors (https://cdn.automationdirect.com/static/manuals/gs3dbm/gs-db_ump.pdf)
5) The selection tables are for 10% duty cycle. If the AC motor drive requires frequent braking, increase the Watts by two to three times.
6) Thermal Overload Relay (TOR):
Thermal overload relay selection is based on its overload capacity. A standard braking capacity of the GS10 is 10% ED (Tripping time=10 s). As shown in the figure below, a 460V, 1kw GS10 required the thermal relay to take 260% overload capacity for 10 seconds (hot starting) and the braking current is 24A. In this case, select a thermal overload relay rated at 10A (10 * 260% = 26 A > 24 A). The property of each thermal relay may vary among different manufacturers. Carefully read the specification before using it.



EMC Shield & Earthing Plates

GS10 EMC Shield Plates

EMC shield plates are available for use with shielded cable and your GS10 drive. Find the frame type from the specification tables of your GS10 and reference the table below:

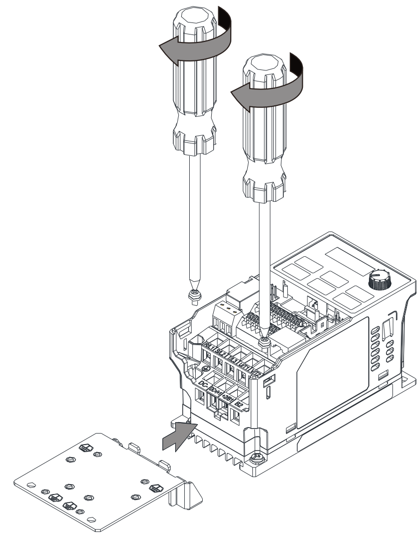
GS10 EMC Shield Plate Selection		
Frame	***EMC Shield Plate Model***	***Reference Drawing***
A	GS20A-ESP-A	 
B	GS20A-ESP-B	 
C	GS20A-ESP-C	 
D	GS20A-ESP-D	 

EMC Shield Plate Installation

The steps below show how to install the EMC shield plate on a GS10 drive. The diagram examples use an A frame model.

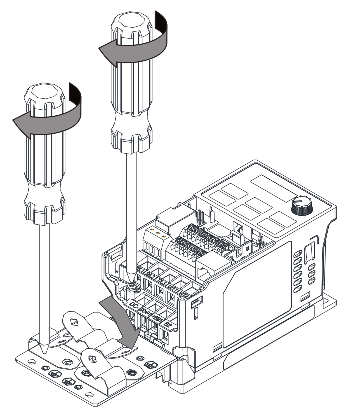
1) Attach the shield plate to the GS10 drive as shown in the diagram to the right.
   Torque the screws per the table below:

Frame	Screw	Torque
A	M3.5	6–8 kg-cm (5.2–6.9 lb-in.) [0.59–0.78 N•m]
B	M4	6–8 kg-cm (5.2–6.9 lb-in.) [0.59–0.78 N•m]
C	M4	6–8 kg-cm (5.2–6.9 lb-in.) [0.59–0.78 N•m]
D	M3	4–6 kg-cm (3.5–5.2 lb-in.) [0.39–0.59 N•m]



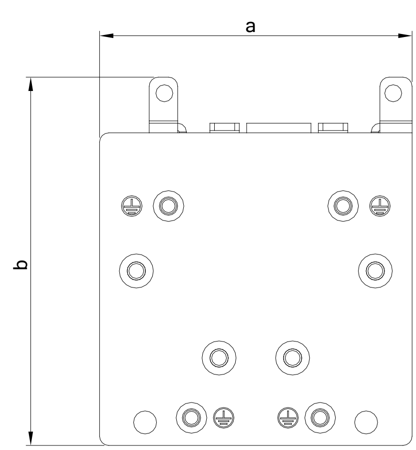
2) Select an R-clip suitable for the wire gauge used and then fix the R-clip to the shield plate as shown in the diagram to the right.
   Torque the R-clip screws per the table below:

Screw	Torque
M4	6–8 kg-cm (5.2–6.9 lb-in.) [0.59–0.78 N•m]



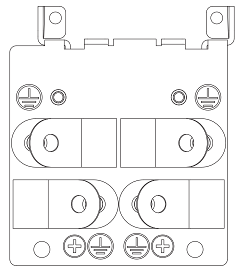
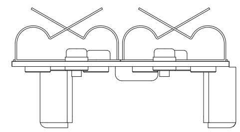
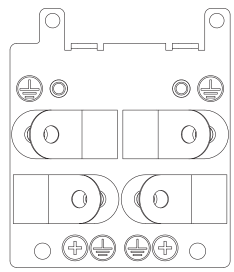
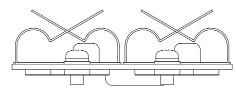
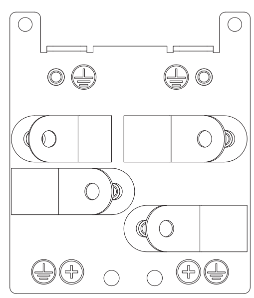
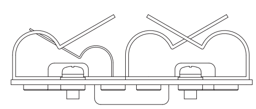
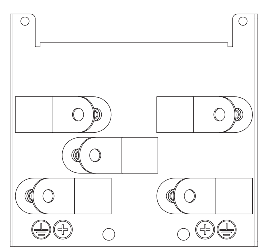
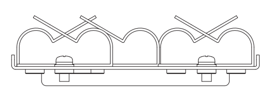
EMC Shield Plate Dimensions

EMC Shield Plate Dimensions		
Model	Dimensions mm [inch]	
	a	b
GS20-ESP-A	69.3 [2.73]	80.0 [3.15]
GS20-ESP-B	67.7 [2.67]	79.7 [3.14]
GS20-ESP-C	78.0 [3.07]	91.0 [3.58]
GS20-ESP-D	103.4 [4.07]	97.0 [3.82]



Recommended Wiring Method

The diagrams below show the recommended R-clip configuration for wiring shielded cable to each frame type/EMC shield plate model.

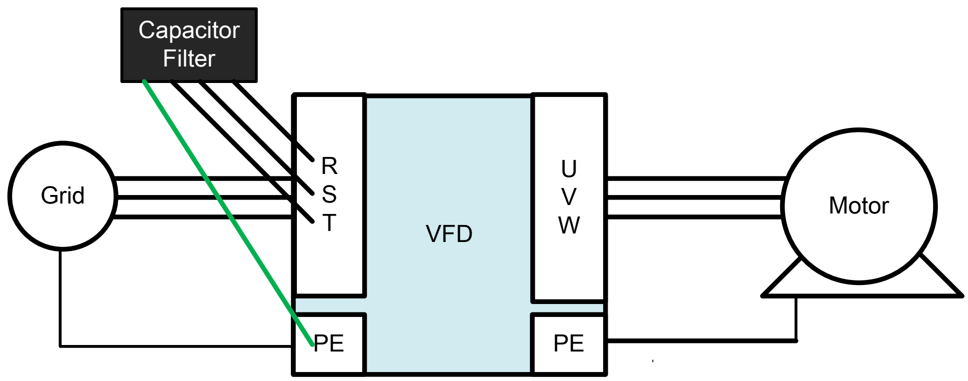
EMC Shield Plate Wiring Methods		
Frame	***EMC Shield Plate Model***	***Reference Drawing***
A	GS20A-ESP-A	 
B	GS20A-ESP-B	 
C	GS20A-ESP-C	 
D	GS20A-ESP-D	 

Capacitive Filter (GS20A-CAPF)

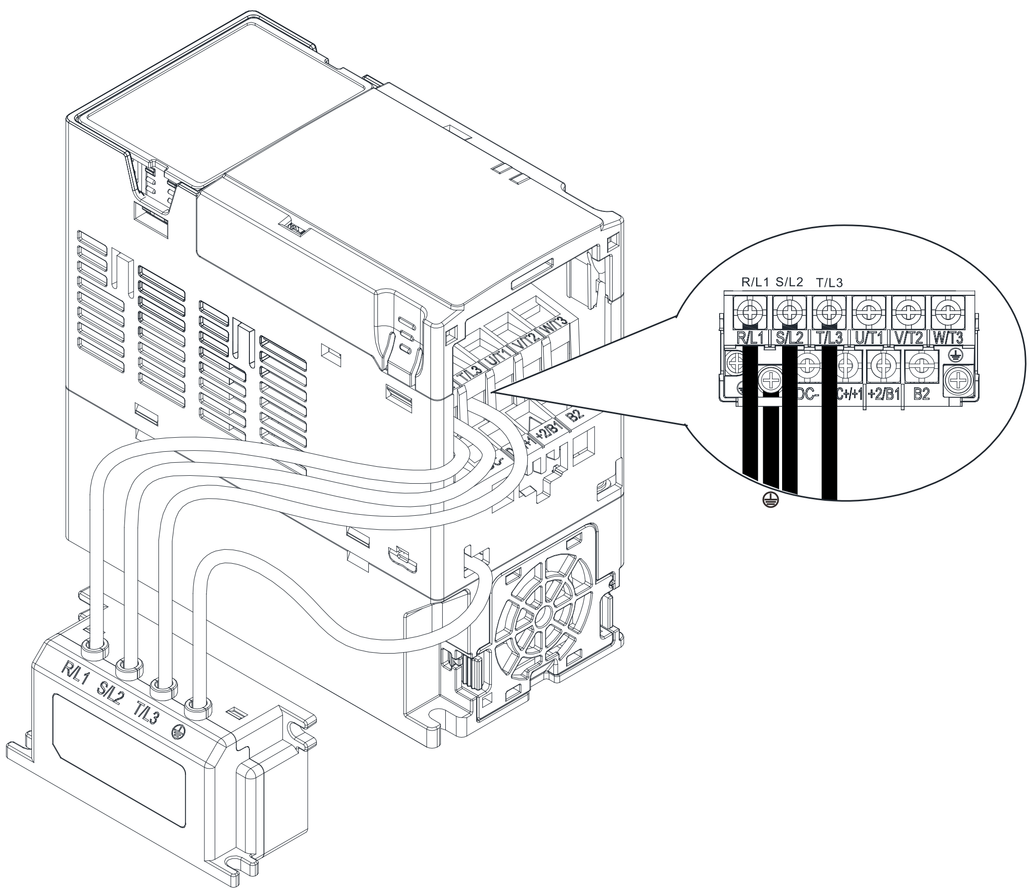
The GS20A-CAPF capacitive filter supports basic filtering and noise interference reduction for models 460V and below.

GS10A-CAPF Specifications			
Model	**Applicable Voltage**	**Temperature Range**	**Capacitance**
GS20A-CAPF	110–480 VAC	-40–85°C	Cx: 1uF ± 20% Cy: 0.1uF ± 20%

Installation diagram:

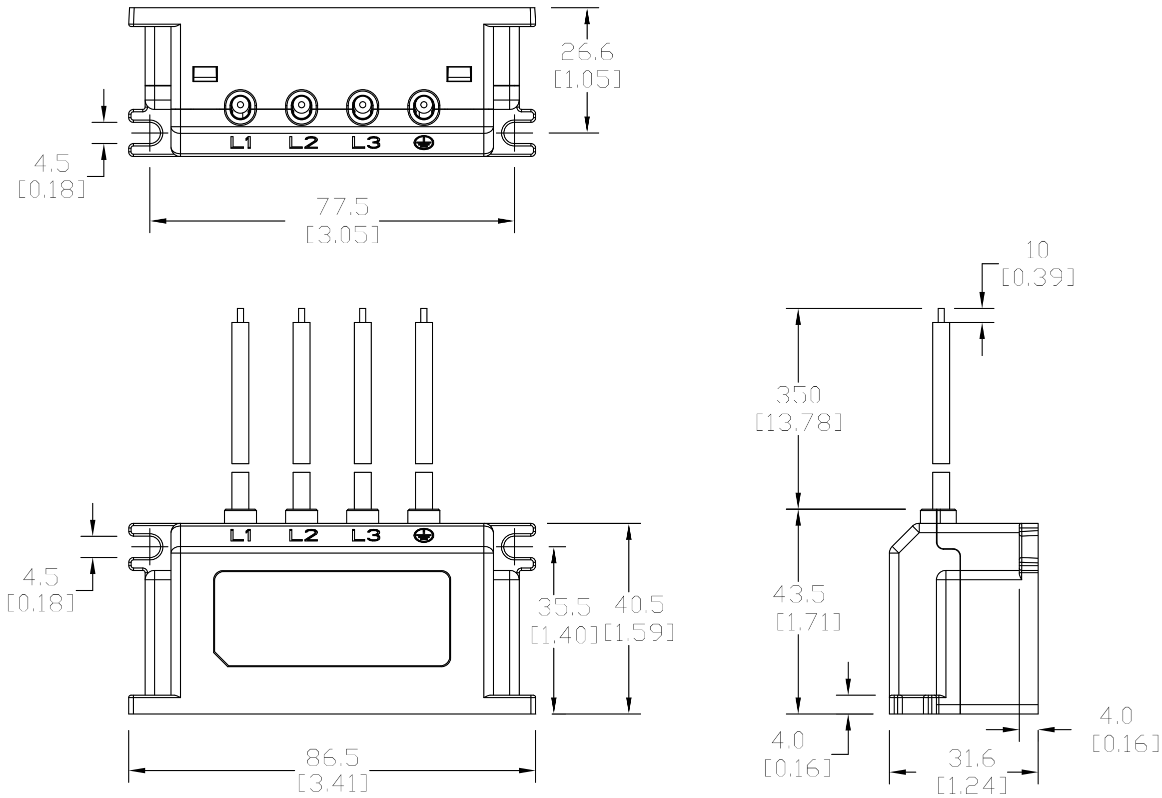


Filter and Drive Wiring



GS20A-CAPF Dimensions

Units = mm [inch]



Conduit Box

NEMA 1 / UL Type 1 compliant conduit boxes are available for all frame sizes (A–D).

Conduit Box Dimensions

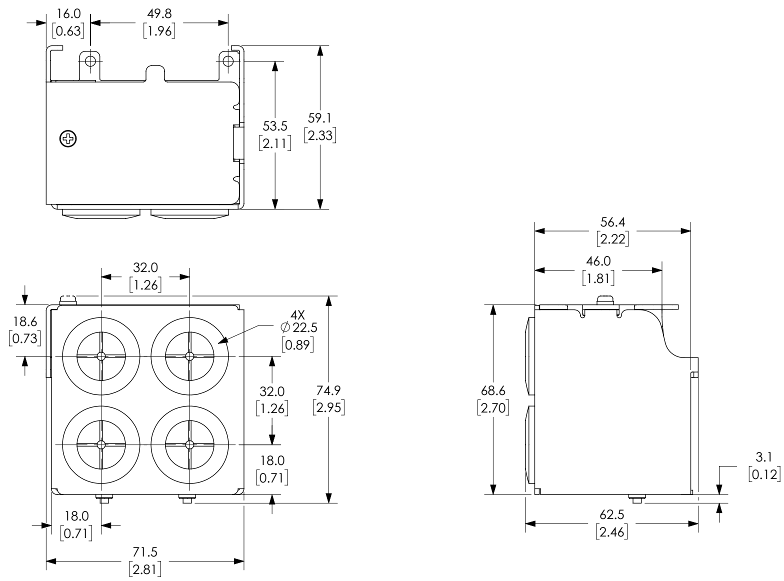
Units = mm [inch]

Frame A1, A2

Applicable models

GS11N-10P2, GS11N-20P2, GS13N-20P2, GS13N-20P5

Conduit Box GS10-N1A1

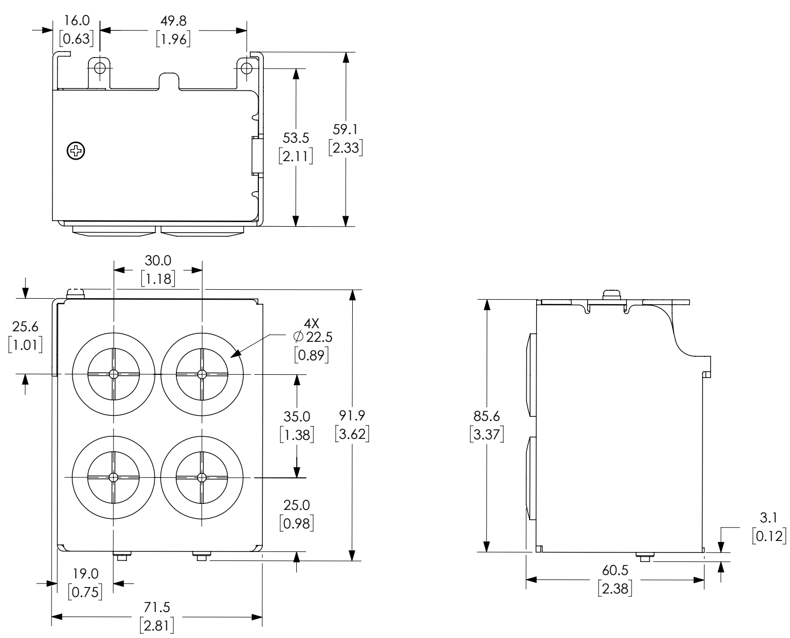


Frame A3–A6

Applicable models

GS11N-10P5, GS11N-20P5, GS13N-21P0, GS13N-40P5, GS13N-41P0

Conduit Box GS10-N1A3



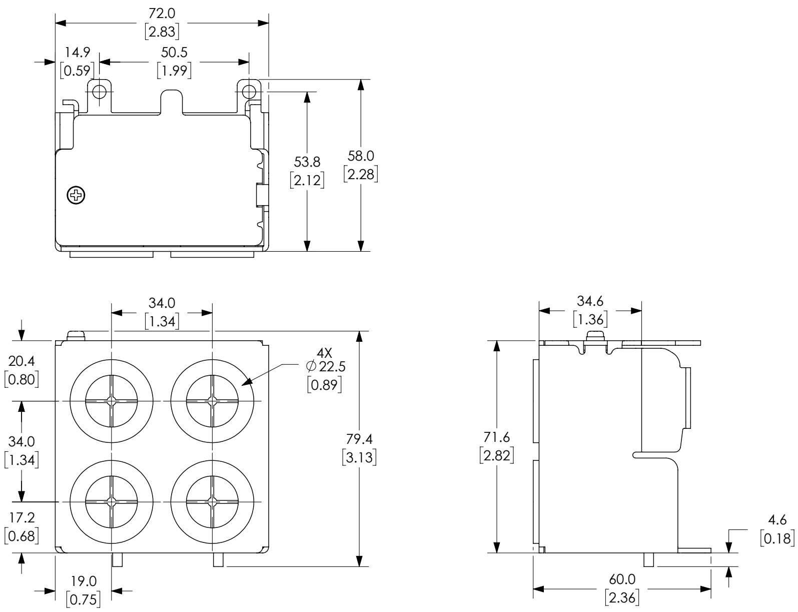
Units = mm [inch]

Frame B

Applicable models

GS11N-21P0, GS13N-22P0, GS13N-41P0

Conduit Box GS10-N1B

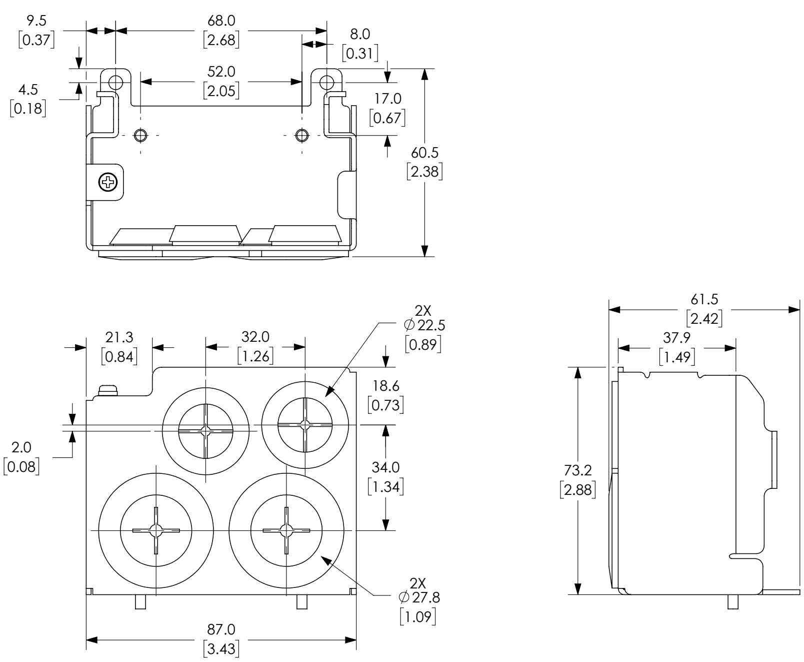


Frame C

Applicable models

GS11N-11P0, GS11N-22P0, GS11N-23P0, GS13N-23P0, GS13N-25P0, GS13N-43P0, GS13N-45P0

Conduit Box GS10-N1C



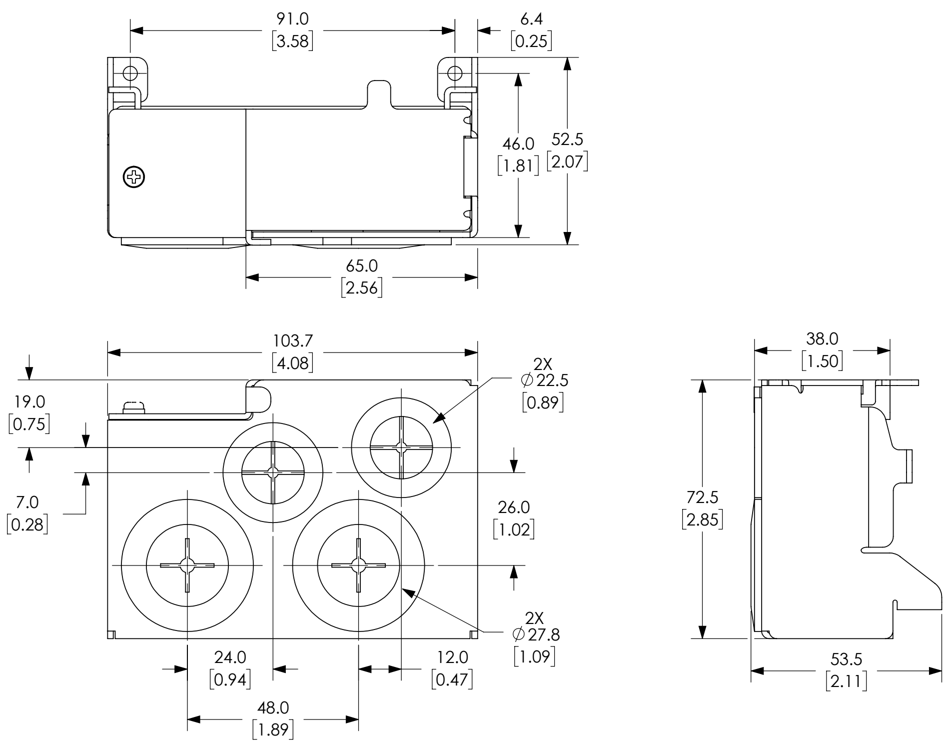
Units = mm [inch]

Frame D

Applicable models

GS13N-27P5, GS13N-47P5, GS13N-4010

Conduit Box GS10-N1D



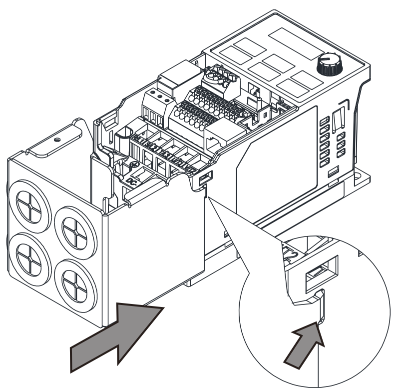
Conduit Box Installation

Follow the steps below to install a conduit box to your GS10 drive. The first set of instructions are for Frame A drives, the second set of instructions is for Frame B–D drives.

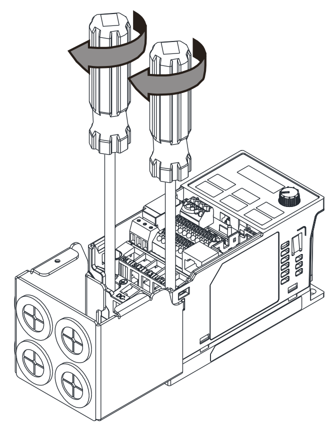
Recommended Screw Size and Torque Value	
Screw	***Torque***
M3	4–6 kg-cm (3.5–5.2 lb-in.) [0.39–0.59 N•m]
M3.5	4–6 kg-cm (3.5–5.2 lb-in.) [0.39–0.59 N•m]
M4	6–8 kg-cm (5.2–6.9 lb-in.) [0.59–0.78 N•m]

Frame A Conduit Box Installation:

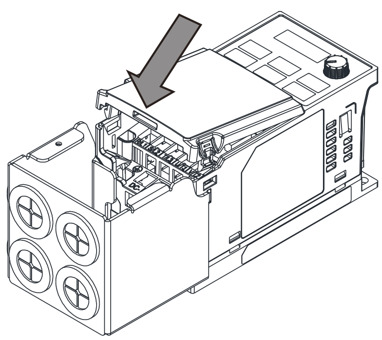
1)



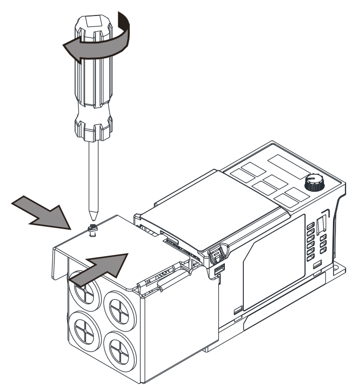
2)



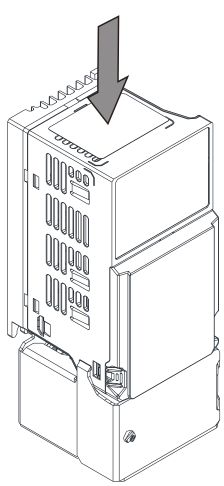
3)



4)

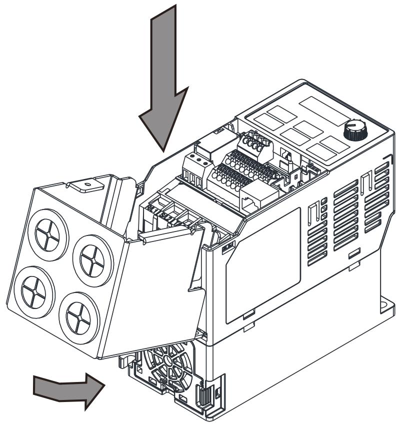


5)

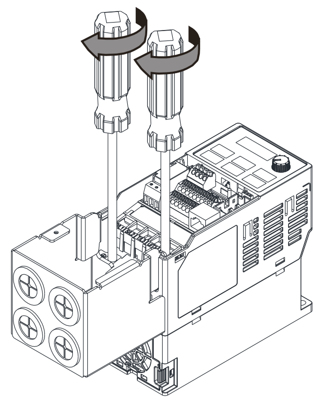


Frame B–D Conduit Box Installation:

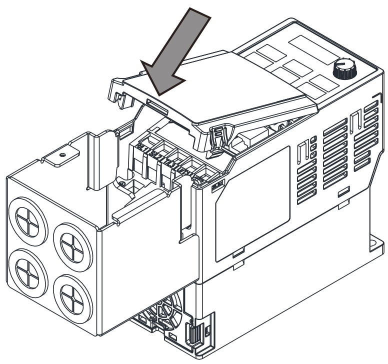
1)



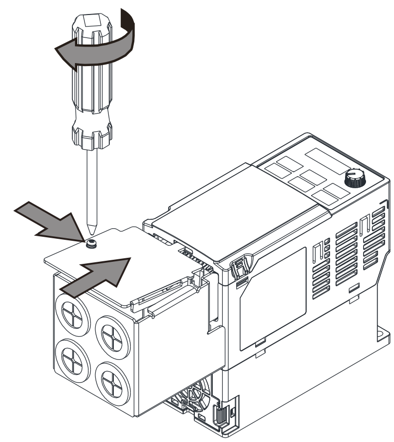
2)



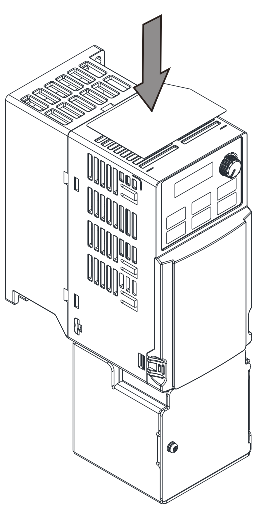
3)



4)

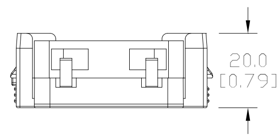
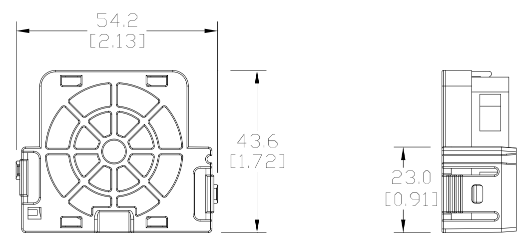
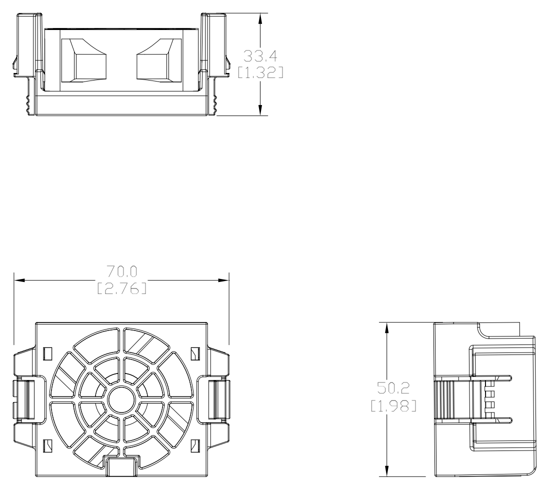
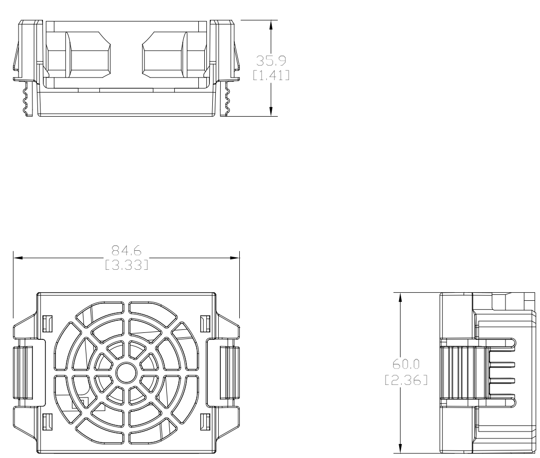


5)

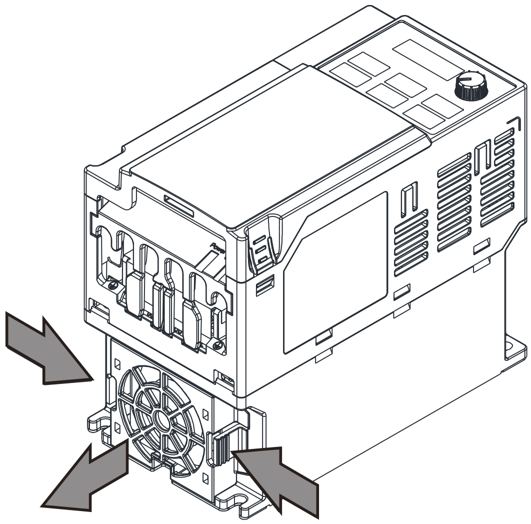
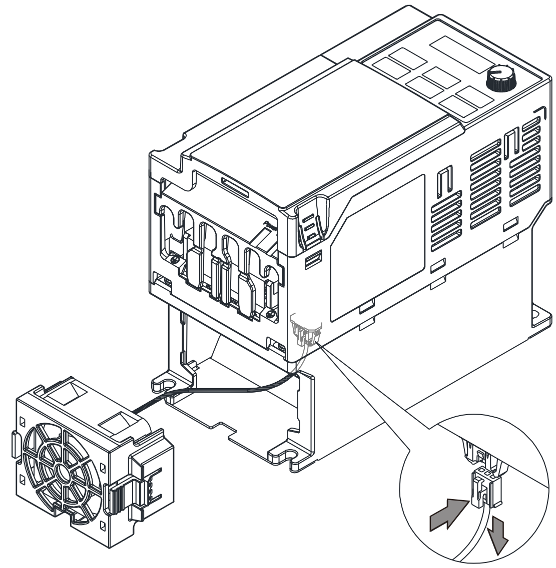


Replacement Fan Kit

Most GS10 drives come equipped with a fan that can be replaced if needed. Use the table below to select the right fan for your drive, then remove and replace the existing fan.

GS10 Fan Kit Selector			
Frame	***Drive Series***	***Fan Kit Model***	***Reference Drawing (units = mm [inch])***
A	GS10	n/a	
B	GS10	GS20A-FAN-B	
C	GS10	GS20A-FAN-C	
D	GS10	GS20A-FAN-D	

GS10 Series Fan Removal

1) As shown in the figure below, press the tabs on both sides of the fan to remove it.	2) Disconnect the power cable while removing the fan.
	

DIN Rail Mounting

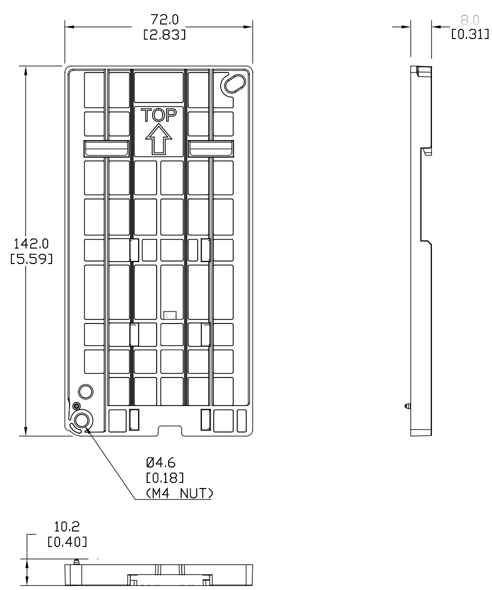
Frame A, B, and C GS10 drives can be DIN rail mounted using a DIN rail mounting kit. One kit is used for A and B frame drives, while a second kit is used for C frame drives.

GS10 DIN Rail Mounting Compatibility		
Drive Model	***Frame***	***Mounting Plate***
GS11N-10P2	A1	GS20A-DR-AB
GS11N-20P2		
GS13N-20P2		
GS13N-20P5	A2	
GS11N-10P5	A3	
GS11N-20P5		
GS13N-40P5	A4	
GS13N-21P0	A5	
GS13N-41P0	A6	
GS13N-22P0	B1	
GS13N-42P0		
GS11N-21P0	B2	
GS11N-22P0	C1	GS20A-DR-C
GS11N-23P0		
GS13N-23P0		
GS13N-25P0		
GS11N-11P0		
GS13N-43P0		
GS13N-45P0		

GS20A-DR-AB

Used with Frame A and B GS10 drives.

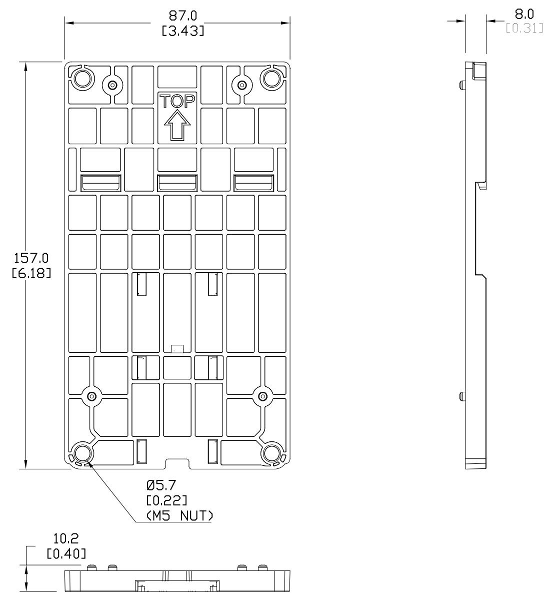
Screw	*Torque*
M4 x 2	8–10 kg-cm (6.9–8.7 lb-in.) [0.78–0.98 N•m]



GS20A-DR-C

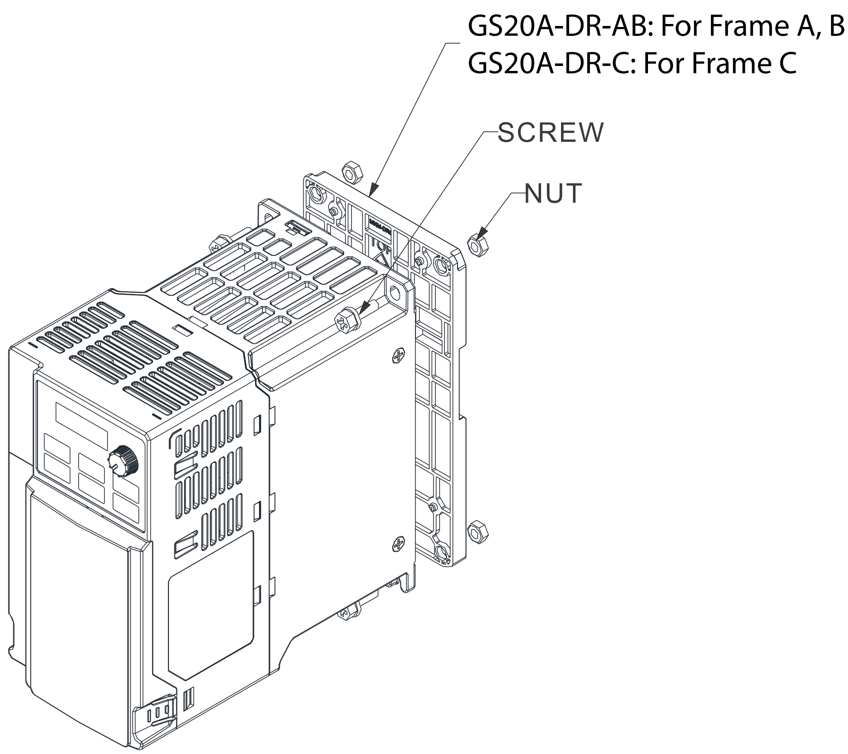
Used with Frame C GS10 drives.

Screw	Torque
M5 x 4	10–12 kg-cm (8.7–10.4 lb-in.) [0.98–1.18 N•m]



GS10 DIN Rail Installation

Attach the GS10 drive to the DIN rail kit mounting bracket as shown below. The diagram is for a Frame C drive, for Frame A or B, use one screw at the top and one at the bottom.



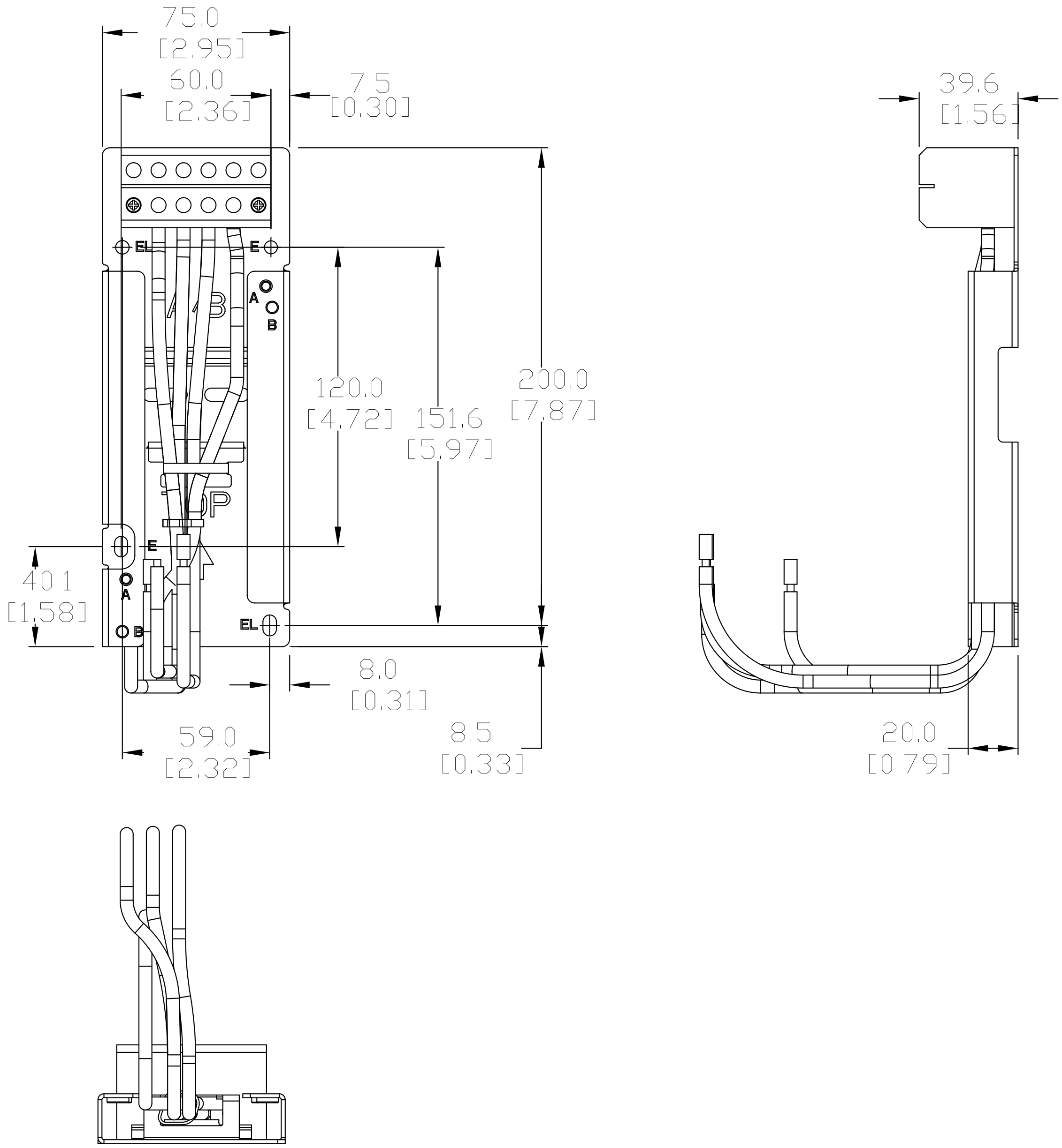
Mounting Adapter Plate

The mounting adapter plate can be used to change the wiring method for the GS10 series and provides flexibility for installation. This accessory changes the wiring method from the "bottom-mains input/ bottom-motor output" to the "top-mains input/bottom-motor output" for GS10. Use the table below to select the correct mounting plate for your drive.

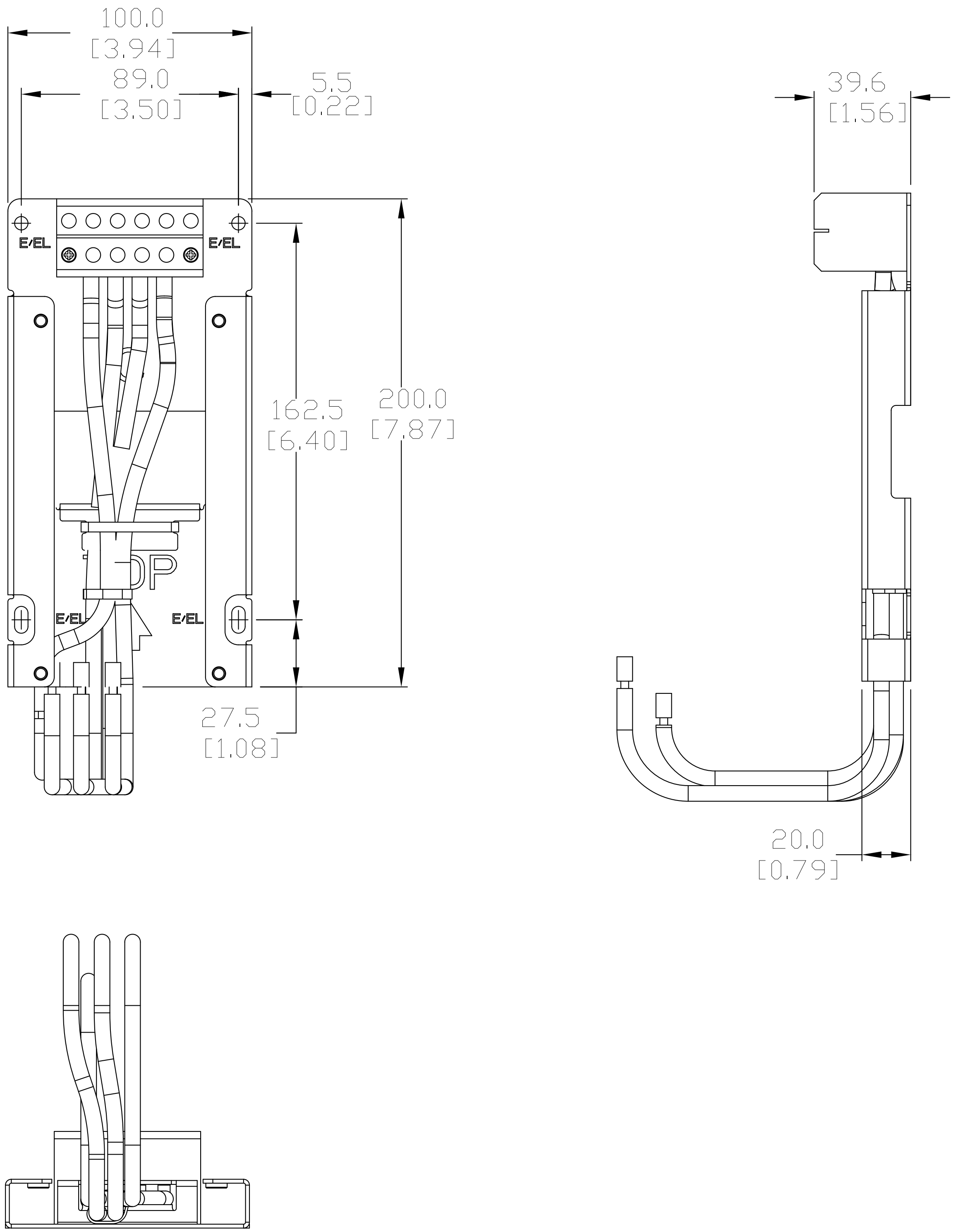
GS10 Mounting Adapter Compatibility		
Drive Model	***Frame***	***Mounting Plate***
GS11N-10P2	A1	GS20A-MP-AB
GS11N-20P2		
GS13N-20P2		
GS13N-20P5	A2	
GS11N-10P5	A3	
GS11N-20P5		
GS13N-40P5	A4	
GS13N-21P0	A5	
GS13N-41P0	A6	
GS13N-22P0	B1	
GS13N-42P0		
GS11N-21P0	B2	
GS11N-22P0	C1	GS20A-MP-C
GS11N-23P0		
GS13N-23P0		
GS13N-25P0		
GS11N-11P0		
GS13N-43P0		
GS13N-45P0		

Mounting Adapter Plate Dimensions

GS20A-MP-AB



GS20A-MP-C

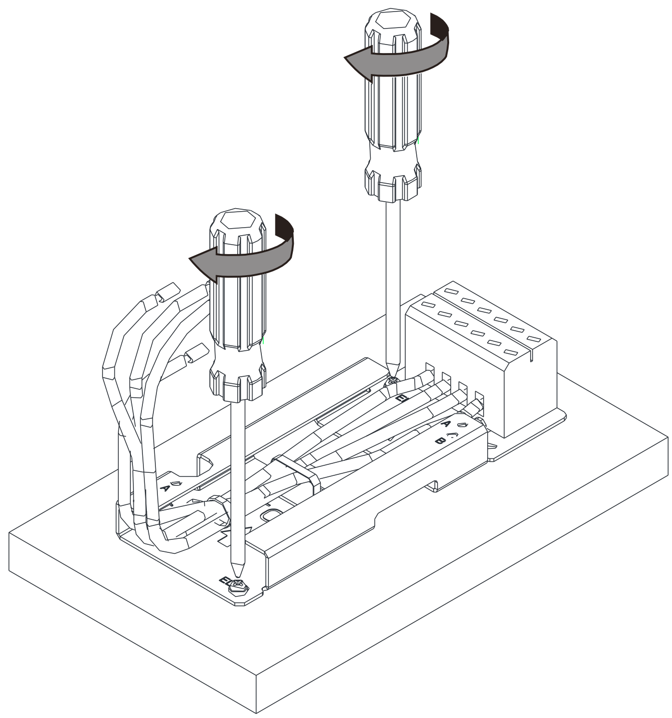

100.0
[3.94]
89.0
[3.50]
5.5
[0.22]
39.6
[1.56]
E/EL
E/EL
162.5
[6.40]
200.0
[7.87]
E/EL
E/EL
27.5
[1.08]
20.0
[0.79]

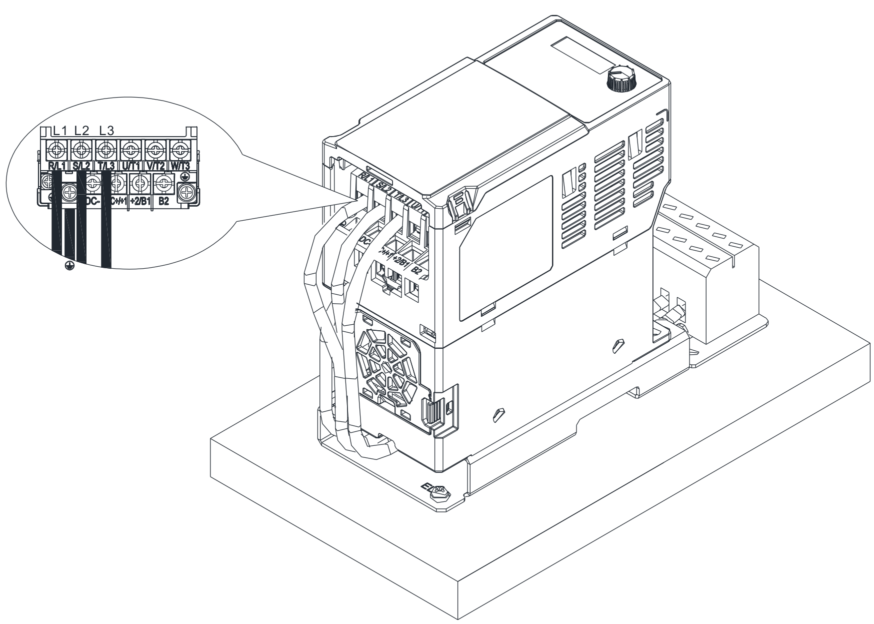
Mounting Adapter Plate Installation

Use the diagrams below and on the following page to install the mounting adapter plate and reroute the wiring.

GS20A-MP-AB

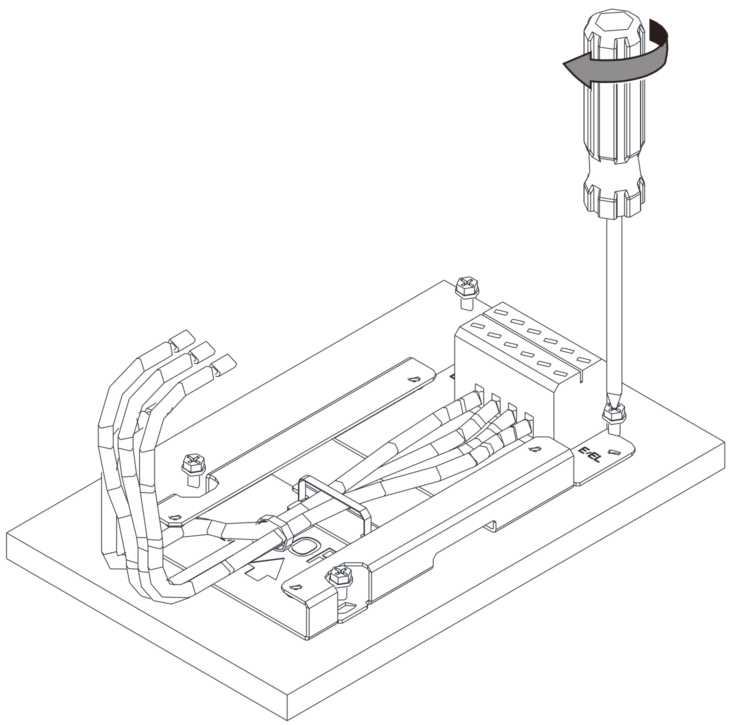
GS10A-MP-AB Screw Size and Torque Value	
Screw	***Torque***
M4	14–16 kg-cm (12.4–13.9 lb-in.) [1.37–1.57 N•m]
M5	16–20 kg-cm (13.9–17.4 lb-in.) [1.57–1.96 N•m]

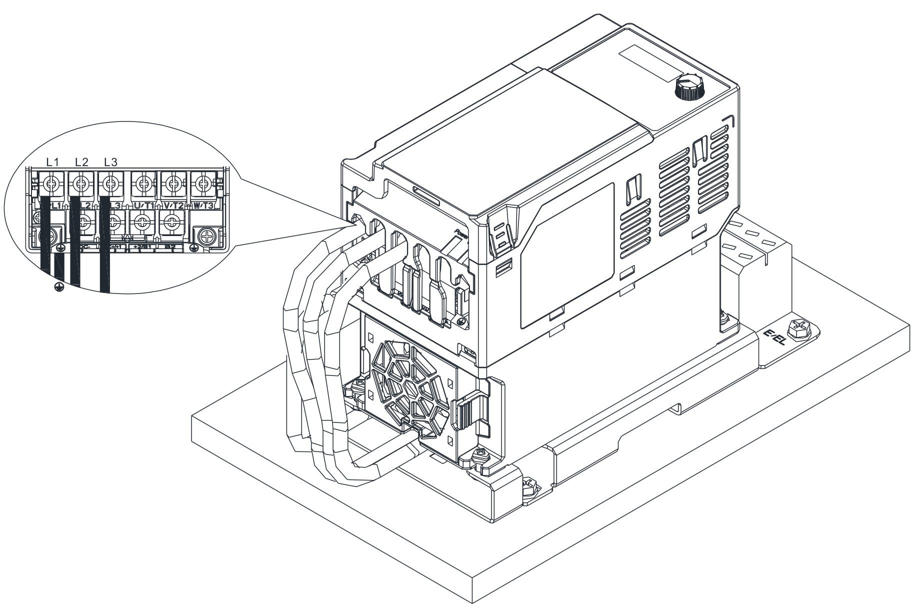




GS20A-MP-C

GS10A-MP-C Screw Size and Torque Value	
Screw	***Torque***
M4	14–16 kg-cm (12.4–13.9 lb-in.) [1.37–1.57 N•m]
M5	16–20 kg-cm (13.9–17.4 lb-in.) [1.57–1.96 N•m]





Optional Advanced Keypad

GS4-KPD

The GS4-KPD can be used with GS10 drives and offers a more advanced interface with additional features. The keypad can be installed flat on the surface any control panel (with or without bezel GS4-BZL). The front cover is IP56 rated.

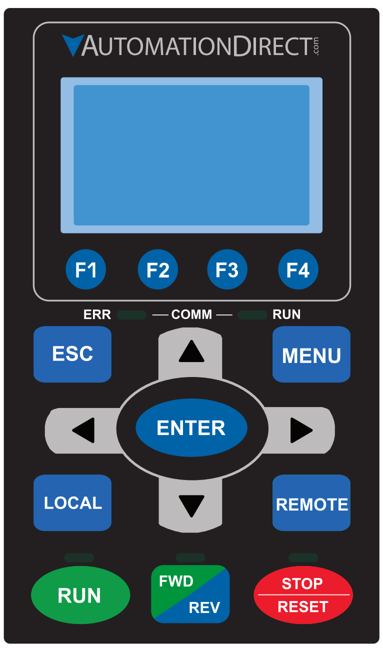
The maximum RJ45 extension lead is 5m (16ft). The keypad communication connection to the drive when mounted remotely can be accomplished by using a standard RJ45 CAT5e straight through patch cable. No other wiring is required. The small RJ45 plastic connector that comes standard with each GS4-KPD kit is not used on GS10.

The communication protocol for GS4-KPD is RTU 19200, 8, N, 2. Therefore, you must set GS10 communication parameters so as to connect with the digital keypad GS4-KPD. The setting steps are as follows:

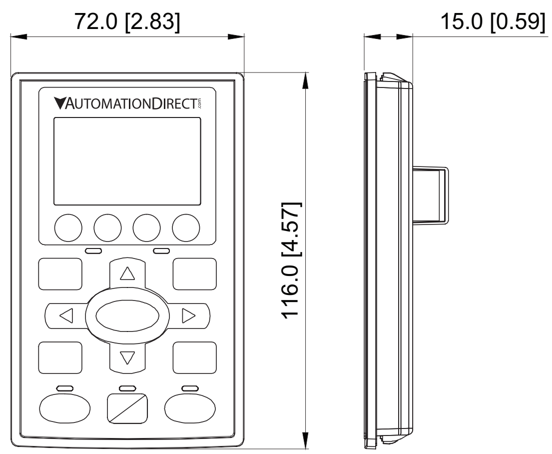
1) Set P09.00 communication address = 1
2) Set P09.01 COM1 transmission speed (Baud rate) = 19.2 Kbps
3) Set P09.04 COM1 communication protocol = 13: 8N2 (RTU)

To control the GS10 drive motion and speed with the keypad, the setting steps are as follows:

1) Frequency control - Parameter P00.20 and/or P00.30 to 1:RS-485 input
2) Operation control- Parameter P00.21 and/or P00.31 to 2: RS-485 input.



RJ45 Connector (included, not used)



Dimensions mm [in]

Descriptions of Keypad Functions	
	**RUN Key** 1) It is only valid when the source of operation command is from the advanced keypad via RS-485. 2) It can operate the AC motor drive by the function setting and the RUN LED will be ON. 3) RUN can be pressed even when drive is in process of stopping. 4) When enabling "LOCAL" mode, it is only valid when the source of operation command is from the advanced keypad via RS-485.
	**STOP/RESET Key** *This key has the highest processing priority in any situation.* 1) When it receives STOP command, whether or not the AC drive is in operation or stop status, the AC motor drive will execute a "STOP" command. 2) The RESET key can be used to reset the drive after the fault occurs. For those faults that can't be reset by the RESET key, see the fault records after pressing MENU key for details.

Continued on next page.

Descriptions of Keypad Functions (*continued*)	
FWD REV	**Operation Direction Key** 1) This key only controls the operation direction and does NOT activate the drive. FWD: forward. REV: reverse. 2) Refer to the LED descriptions for more details.
ENTER	**ENTER Key** Press ENTER and go to the next menu level. If it is the last level, then press ENTER to execute the command.
ESC	**ESC Key** The ESC key function serves to leave the current menu and return to the last menu. It also functions as a return key while in the sub-menu.
MENU	**MENU Key** Press MENU to return to the main menu. Menu Content: 1) Param Setup 2) Quick Start (Function not Available) 3) Keypad Lock 4) Fault Record 5) PLC (Function not Available) 6) Copy Param 7) Copy PLC (Function not Available) 8) Displ Setup 9) Time Setup 10) Language 11) Start-up
▲ ◄ ► ▼	**Direction: Left/Right/Up/Down** 1) In the numeric value setting mode, it is used to move the cursor and change the numeric value. 2) In the menu/text selection mode, it is used for item selection.
F1 F2 F3 F4	**Function Keys** 1) F1 is JOG function 2) The F2, F3, F4 keys are reserved for future use.
LOCAL	**LOCAL Key** 1) This key is executed by the parameter settings of the source of Local frequency and Local operation. The factory settings of both source of Local frequency and Local operation are the digital keypad. 2) Pressing the LOCAL key with the drive stopped will switch the operation and frequency to the LOCAL source. Pressing the LOCAL key with the drive running will stop the drive, with "AHSP" warning displayed and when stopped, will switch the operation and frequency source to the LOCAL source. 3) The selected mode, LOCAL or REMOTE, will be displayed on the GS4-KPD. 4) When P00.29=0 then LOCAL correlates to HAND mode. The Digital Input Definition must not be set to 56 (LOC/REM Switch). *Refer to P00.29 for more detail and other options on how the drive behaves when switching between LOCAL and REMOTE.*
REMOTE	**REMOTE Key** 1) This key is executed by the parameter settings of the source of Remote frequency and Remote operation. The digital keypad is the the factory default source for both Remote frequency and Remote operation. 2) Pressing the REMOTE key with the drive stopped will switch the operation and frequency to the REMOTE source. Pressing the REMOTE key with the drive running will stop the drive, with “AHSP” warning displayed and when stopped, will switch the operation and frequency source to the REMOTE source. 3) The selected mode, LOCAL or REMOTE, will be displayed on the GS4-KPD. 4) When P00.29=0 then LOCAL correlates to HAND mode. The Digital Input definition must not be set to 56 (LOC/REM Switch). *Refer to P00.29 for more detail and other options on how the drive behaves when switching between LOCAL and REMOTE.*

Descriptions of LED Functions	
RUN	**Steady ON**: Operation indicator of the AC motor drive, including DC brake, zero speed, standby, restart after fault and speed search. **Blinking**: Drive is decelerating to stop or in the status of base block. **Steady OFF**: Drive is not currently executing an operational (RUN) command.
STOP / RESET	**Steady ON**: Stop indicator of the AC motor drive. **Blinking**: Drive is in the standby status. **Steady OFF**: Drive is not currently executing an operational (STOP) command.
FWD / REV	**Operation Direction LED** 1) Green light is on, the drive is running forward or will run forward when given a run command. 2) Red light is on, the drive is running backwards or will run backwards when given a run command. 3) Alternating green/red light: the drive is changing direction.
ERR — COMM — RUN	**ERR_COMM_RUN** Descriptions reserved for future use.

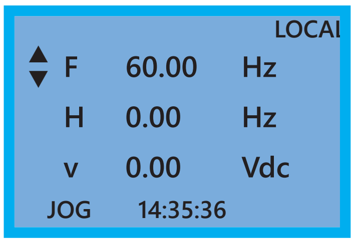
GS10 Display Screens for GS4-KPD

Start-Up Display

At power up, the Start-up Page displays the *DURAPULSE*, GS10 logo. This page is replaced by the Status Page in 3 seconds.

Pressing the UP Arrow while the Start-up Page is displayed will show the current keypad firmware.

Status Page



Drive status:
Press the LOCAL key to allow local control of the drive.
Press the REMOTE key to allow remote control of the drive.
Pressing the Up and Down Direction keys allow the user to scroll through the Status Page items.
F X.xx Hz (actual GS10 command frequency)
H X.xx Hz (actual GS10 output frequency)
U XXX.x User defined value (in this example P00.04 = 3 DC bus voltage*
A X.xx Amp (output amperage)
JOG and time:
JOG appears above the F1 key and is the function assigned to that key.
The internal clock is displayed, center bottom.

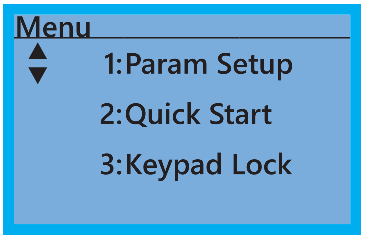
NOTE: When Power is applied, the keypad will display the startup Page followed by the Status Page. The Status Page displays the GS10 default settings F/H/U/A. While the order F/H/U/A is always fixed, P00.03 can be used to set which value appears on the top row at power-up. The UP and DOWN Arrows will scroll through the display options.

NOTE: If an "Err" appears on the keypad after pressing <Enter> in any menu or parameter, then the action did not take affect. The keypad will report back "End" if the action was performed correctly. Ex: writing a value out of range to a parameter will cause a "Err" message.

** NOTE: Refer to Parameter P00.04 in Chapter 4, AC Drive Parameters for a complete list of the values that can be displayed on line 3 of the keypad display. The value in P00.04 is the value that will be shown when the drive powers up. By scrolling to the User Defined row, the Left and Right Direction keys can be used to display any of the other selections available.*

NOTE: The GS4-KPD is connected to the GS10 by the RJ45 communiations port with a standard ethernet cable. The following communications settings must be used: P09.01=19.2 (kBps) and P09.04=13 (8N2 RTU).

Menu Page

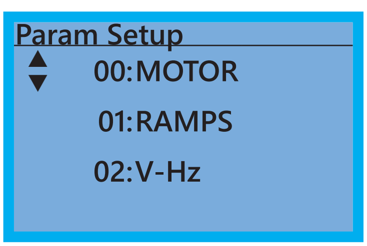


Press the Menu button from any page to access the Menu Page. Use the Up and Down Direction keys to scroll through the Menu content. Press the Enter key to open the selected Menu content item.

1: Param Setup - Parameter Setup
 Set up the individual drive parameters.
2: Quick Start - This function not available for GS10.
3: Keypad Lock
 Lock the Keypad.
4: Fault Record
 Display fault information for the drive.
5: PLC - This function not available for GS10.
6: Copy Param - Copy Parameters
 Save drive parameters to the keypad or drive.
7: Copy PLC - This function not available for GS10.
8: Displ Setup
 Adjust contrast and backlight settings for the display.
9: Time Setup
 Set the time.
10: Language*
 Set the display language.
11: Start-up
 Set the Start-up Page display.

**NOTE: Language is only for the Menu level. Parameters and Parameter options remain in English.*

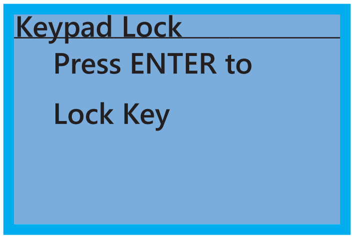
Param Setup - Parameter Setup Page



See the individual parameter summary tables in *Chapter 4 - AC Drive Parameters* for specific parameter explanations and settings.

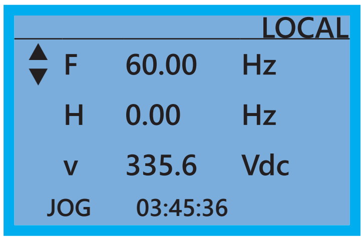
00: DRIVE
01: BASIC
02: DIGITAL
03: ANALOG
04: SPEED
05: MOTOR
06: PROTECT
07: SPECIAL
08: PID
09: COMMUNICATION
10: FEEDBACK
11: ADVANCED
12: FUNCTION
13: USER
14: PROTECT(2)

Keypad Lock - Keypad Lock Page

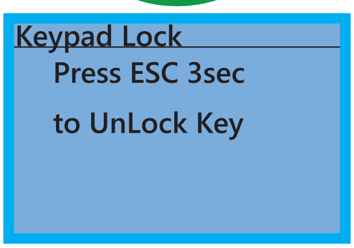


Keypad Lock is used to lock the keypad from unintentional activation during operation.

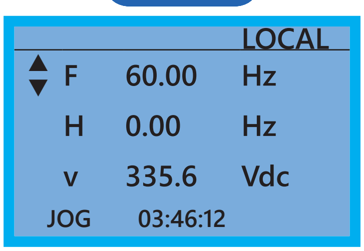
Press the Enter key to lock the keypad.



The Status Page will again display.

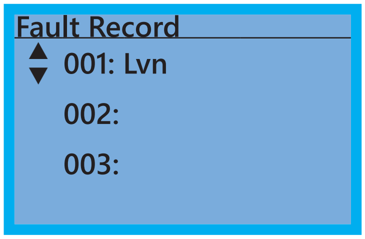


Pressing ANY key will display the message Press ESC to UnLock Key.



Press and hold the ESC key for 3 seconds to unlock the keypad. The display will return to the Status Page.

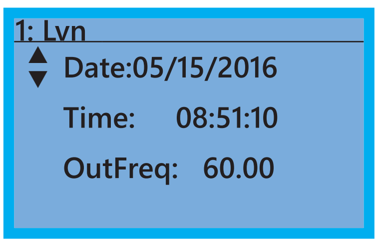
Fault Record - Fault Record Page



GS10 drive faults are stored from 1: to 20:. Refer to *Chapter 6: Maintenance and Troubleshooting* for a complete list of fault messages that may appear. Use the Up and Down Direction keys to scroll through the list.

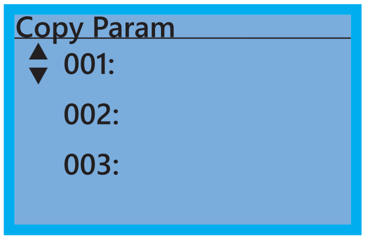
1:
2:
3:
▲
▼
18:
19:
20:

Press the Enter key to display information about the drive status when the fault occurred.



Date: 00/00/0000
Time: 00:00:00
OutFreq: 0.00
OutAmp: 0.00
OutVolt 0.0
DCBus: 0.0

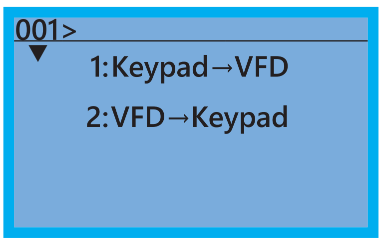
Copy Param - Copy Parameters Page (Keypad Copy)



Copy Parameters is used to save up to four drive configurations into the keypad. The keypad can then download any of these configurations into the drive, or it can be moved to a different drive and download the parameter settings of the original drive. Use the Up and Down Direction keys to scroll through the four available copy parameter locations. If a field is blank, then no copy has been made to that location.

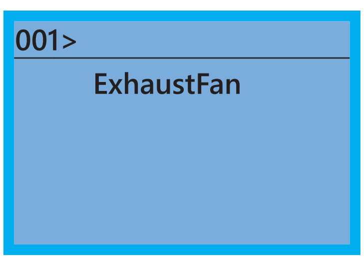
001: ExhaustFan
002: IntakeFan1
003: Filename02
004:

Press the Enter key to select the desired location for writing the current parameter settings.



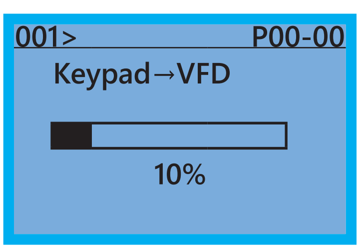
Use the Up and Down Direction keys to select Keypad→VFD to copy the current parameter settings from the keypad to the drive or VFD→Keypad to write the current parameter settings from the drive to the keypad. Press the Enter key.

VFD→ Keypad



After VFD→Keypad is selected, the keypad will prompt you for a filename to save the existing configuration into. Use the Left/Right Arrows to scroll from character to character and the Up/Down Arrows to change the alphanumeric character. Pressing Enter will begin the transfer of parameters from the drive into the keypad.

Keypad→ VFD

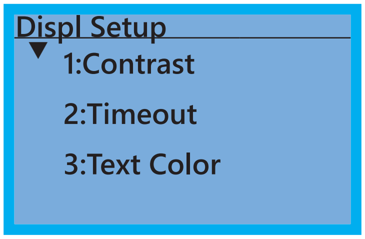


When Keypad→VFD is selected, the keypad will begin the transfer of the preselected file parameters from the keypad into the drive.

As shown in the example to the left, “001” is the file to be transferred.

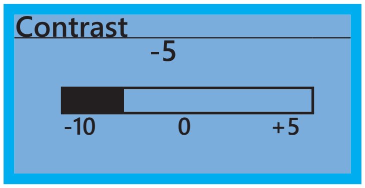
Pressing F4 while in the Copy Param menu will prompt you to Delete All 4 saved programs (“Press ENTER to clear”).

Displ Setup - Display Setup Page

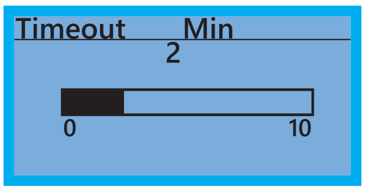


The Display Setup Page allows the user to adjust the Contrast, Backlight time and Text Color of the display.

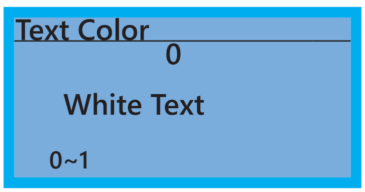
1: Contrast
2: Timeout
3: Text Color



Use the Up and Down direction arrows to adjust the Contrast to the desired setting.
The range of adjustment is from -20 to +20.
The default value is 0.
Entering a value of 0 will keep the backlight ON all the time.

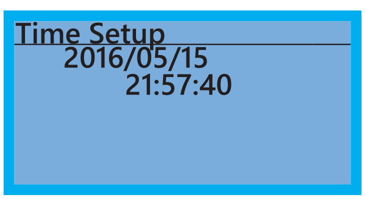


Use the Up and Down direction arrows to adjust the time when the display backlight turns off. The range of adjustment is from 0 to 10 minutes. The default value is 5 minutes.



Use the Up and Down direction arrows to select from white text or blue text for the display.

Time Setup - Time Setup Page

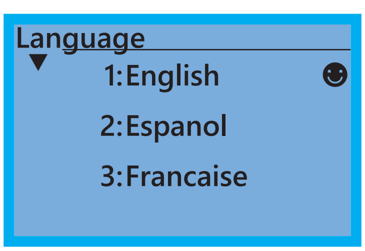


The Time Setup Page allows the user to change the date and time. The date format is Year/Month/Day. Time is displayed in 24-hour clock format and is displayed as Hours:Minutes:Seconds. Use the Right and Left Arrow keys to move the cursor to the desired location and use the Up and Down Arrow keys to adjust the setting.

After adjusting the time, move the cursor to the Seconds entry before pressing the Enter Key.

The real time clock (RTC) is maintained in the keypad. A capacitor is used to provide power for the RTC during power loss. The capacitor can maintain power for the RTC for 7 days with no drive power applied.

Language - Language Page



The Language Page sets the language shown on the display. Select from English, Spanish or French. The translation applies to the keypad menu structure only. The Detailed parameter settings will remain in English.

Start-up - Start-up Page

Start-up
▼ 1:Default1 ☻
2:Default2

The Start-up Page allows the user to select from two different screens that display during initial start-up. Default1 setting displays the GS10 logo screen, Default2 setting displays "Initializing, Please Wait."

Keypad Fault Codes

Following are the fault codes and descriptions for the GS4-KPD. To reset the fault codes press the Enter and Reset buttons simultaneously. These faults indicate either a communication error between the keypad and the drive or a keypad failure. To correct: 1) Inspect and clean the RJ45 connectors on the back of the keypad and the RJ45 connector leading into the drive. 2) Replace the cable and/or RJ45 M-M adapter with a standard Ethernet patch cable. 3) If the RJ45 connections are OK, replace the keypad.

① Fault LOCAL
② FrEr
③ kpdFlash Read Er

① Display error signal

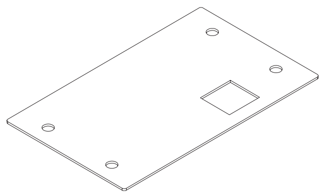
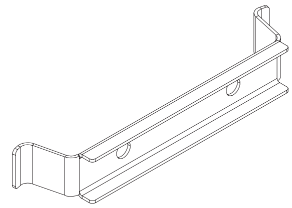
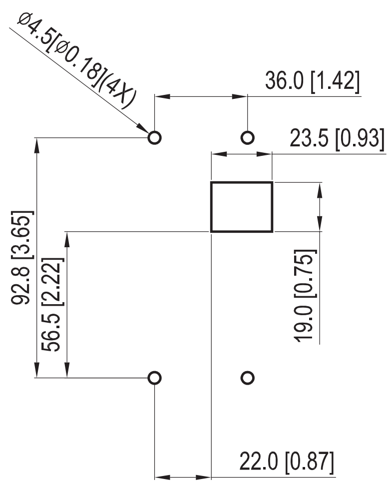
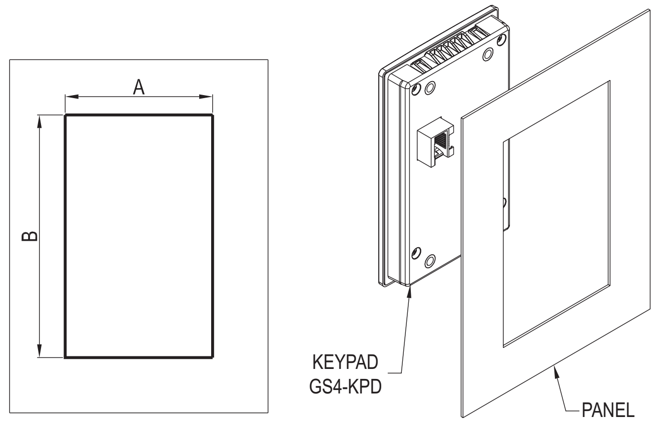
② Abbreviated error code
The code is displayed as shown on GS4-KPD

③ Display error description

ID No.	Description	Corrective Actions
Fault LOCAL FrEr kpdFlash Read Er	Keypad flash memory read error.	An error has occurred on keypad's flash memory. 1. Press RESET on the keypad to clear the error. 2. Verify what kind of error has occurred on keypad's flash memory. 3. Shut down the system, wait 10 minutes and power up the system. If the error remains contact technical support.
Fault LOCAL FSEr kpdFlash Save Er	Keypad flash memory save error.	An error has occurred on keypad's flash memory. 1. Press RESET on the keypad to clear the error. 2. Verify what kind of error has occurred on keypad's flash memory. 3. Shut down the system, wait 10 minutes and power up the system. If the error remains contact technical support.
Fault LOCAL FPEr kpdFlash Pr Er	Keypad flash memory parameter error.	Errors occurred on factory setting parameters possibly caused by firmware update. 1. Press RESET on the keypad to clear the error. 2. Verify if there is a problem on the FLASH IC. 3. Shut down the system, wait 10 minutes and power up the system. If the error remains contact technical support.
Fault LOCAL VFDr Read VFD Info Er	Keypad flash memory when read AC data error.	Keypad can't read data from drive. 1. Verify if the keypad is properly connected to the drive with the RJ45 connector. 2. Press RESET on the keypad to clear the error. 3. Shut down the system, wait 10 minutes and power up the system. If the error remains contact technical support.
Fault LOCAL ERR88 Type Mismatch	Keypad/Drive parameter file mismatch.	There has been an attempt to copy an incorrect file between the keypad and the drive. Ensure that there is a valid file in the keypad (if attempting Keypad → VFD transfer).

Keypad Panel Mounting Kit GS4-BZL

This panel mounting kit can be used for wall mounting or embedded mounting of the GS4-KPD.

Wall Mounting	Embedded Mounting
Accessory 1  Screws: (4) M4*p 0.7 *L8mm Torque: 10-12 kg·cm (8.7-10.4lb-in.)	Accessory 2  Screws: (4) M4*p 0.7 *L8mm Torque: 10-12 kg·cm (8.7-10.4 lb·in)
 Panel cutout dimensions mm [in]	 Normal cutout dimension

Normal cutout dimension

Panel Thickness	1.2 mm	1.6 mm	2.0 mm
A	66.4 [2.614]		
B	110.2 [4.339]	111.3 [4.382]	112.5 [4.429]

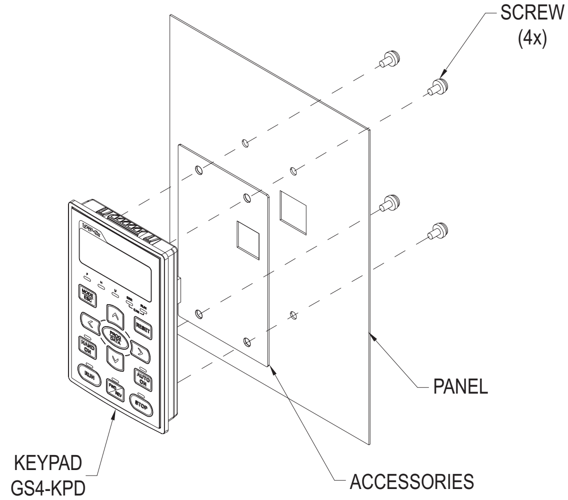
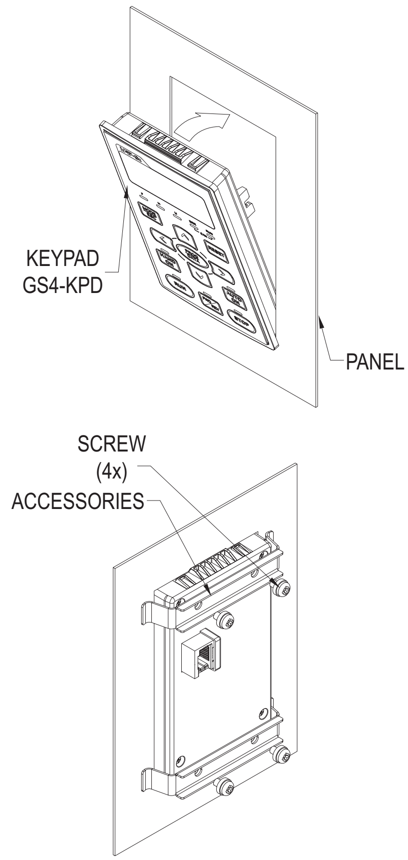
* Deviation: ± 0.15 mm / ± 0.0059 in

Cutout dimension (Waterproof level: IP56)

Panel Thickness	1.2 mm	1.6 mm	2.0 mm
A	66.4 [2.614]		
B	110.8 [4.362]		

* Deviation: ± 0.15 mm / ± 0.0059 in

Continued on next page.

<table>
<tr><th>Wall Mounting</th><th>Embedded Mounting</th></tr>
<tr><td>
</td><td>
</td></tr>
</table>

Digital and Analog I/O Parameter Maps

Appendix B

Table of Contents

Introduction

This section contains worksheets to help with designing and programming the physical inputs and outputs of the GS10 (digital, analog, and frequency interfaces). These worksheets provide the GS10 parameters and addresses associated with each input and output. For detailed parameter descriptions, please see Chapter 4 “AC Drive Parameters”. For more detailed wiring information, please see Chapter 2 “Installation and Wiring.

Digital and analog I/O parameter maps begin on the following page.

GS10 Digital Inputs

GS10 Digital Inputs						
GS10 Terminals	FWD/DI1	REV/DI2	DI3	DI4	DI5	Comments
Parameter	**P02.00** if ≠ 0, else: **P02.01**	**P02.00** if ≠ 0, else: **P02.02**	**(P02.00** if=**3 or 6)** else **P02.03**	**P02.04**	**P02.05**	See Digital Input Configurations Below
Default Setting	**P2.00**=1, **P02.01**=0	**P02.00**=1, **P02.02**=0	1	2	3	
Default Configuration	2 wire mode: FWD/STOP	2 wire mode: REV/STOP	Multi Spd 1	Multi Spd 2	Multi Spd 3	
User Defined Selection / Value						
DI - N.C. / N.O. Select **P02.12 - Bit #**	0	1	2	3	4	0 = N.O. 1 = N.C.
Default Configuration	0 = Normally Open					
User Defined Selection / Value						
DI - Response Time	**P02.11**					0 to 30.000 seconds
Default Configuration	0.005 seconds					
User Defined Selection / Value						
DI - Active Status Monitor **P02.50 - Bit #**	0	1	2	3	4	Read Only!

Digital Input Configurations – Parameters P02.01~P02.05		
0: No function 1: Multi-step speed command 1 2: Multi-step speed command 2 3: Multi-step speed command 3 4: Multi-step speed command 4 5: Reset 6: JOG [by external control or GS4-KPD (optional)] 7: Acceleration / deceleration speed inhibit 8: 1st and 2nd acceleration / deceleration time selection 9: 3rd and 4th acceleration / deceleration time selection 10: External Fault (EF) Input (P07.20) 11: Base Block (B.B.) input from external source 12: Output stop 13: Cancel the setting of autoacceleration / auto-deceleration time	15: Rotating speed command from AI-V 18: Force to stop (P07.20) 19: Digital up command 20: Digital down command 21: PID function disabled 22: Clear the counter 23: Input the counter value (DI4) 24: FWD JOG command 25: REV JOG command 27: ASR1 / ASR2 selection 28: Emergency stop (EF1) 29: Signal confirmation for Y-connection 30: Signal confirmation for δ-connection 38: Disable writing EEPROM function 39: Torque command direction 40: Force coasting to stop 41: HAND switch 42: AUTO switch 49: Enable drive	50: Slave dEb action to execute 56: Local / Remote selection 58: Enable fire mode (with RUN command) 59: Enable fire mode (without RUN command) 70: Force auxiliary frequency return to 0 71: Disable PID function, force PID output return to 0 72: Disable PID function, retain the output value before disabled 73: Force PID integral gain return to 0, disable integral 74: Reverse PID feedback 83: Multi-motor (IM) selection bit 0 94: Programmable AUTO RUN 95: Pausing AUTO RUN 97: Multi-pumps switch by Hand / Auto mode 98: Simple positioning stop by forward limit 99: Simple positioning stop by reverse limit

GS10 Digital Outputs

GS10 Digital Outputs			
GS10 Terminals	R1-R1C-R1O	DO1-DOC	Comments
Parameter	**P02.13**	**P02.16**	See Digital Output Configurations Below
Default Setting	11	0	
Default Configuration	Malfunction Indication	No Function	
User Defined Selection / Value			
DO - N.C. / N.O. Select **P02.18 - Bit #**	0	3	0 = N.O. 1 = N.C.
Default Configuration	0	0	
User Defined Selection / Value			
DO - Active Status Monitor **P02.51 - Bit #**	0	3	Read Only!

Digital Output Configurations – Parameters P02.13 and P02.16		
0: No function 1: Indication during RUN 2: Operation speed reached 3: Desired frequency reached 1 (P02.22) 4: Desired frequency reached 2 (P02.24) 5: Zero speed (Frequency command) 6: Zero speed including STOP (Frequency command) 7: Over-torque 1 (P06.06–06.08) 8: Over-torque 2 (P06.09–06.11) 9: Drive is ready 10: Low voltage warning (Lv) (P06.00) 11: Malfunction indication 13: Overheat warning (P06.15) 14: Software brake signal indicator (P07.00) 15: PID feedback error (P08.13, P08.14) 16: Slip error (oSL) 17: Count value reached, does not return to 0 (P02.20) 18: Count value reached, return to 0 (P02.19)	19: External interrupt B.B. input (Base Block) 20: Warning output 21: Over-voltage 22: Over-current stall prevention 23: Over-voltage stall prevention 24: Operation mode 25: Forward command 26: Reverse command 29: Output when frequency ≥ P02.34 30: Output when frequency < P02.34 31: Y-connection for the motor coil 32: δ-connection for the motor coil 33: Zero speed (actual output frequency) 34: Zero speed including STOP (actual output frequency) 35: Error output selection 1 (P06.23) 36: Error output selection 2 (P06.24) 37: Error output selection 3 (P06.25) 38: Error output selection 4 (P06.26) 40: Speed reached (including STOP)	42: Crane function 43: Motor speed detection 44: Low current output (use with P06.71–06.73) 45: UVW output electromagnetic valve switch 46: Master dEb output 51: Analog output control for RS-485 interface 53: Fire mode indication 67: Analog input level reached 69: Indication of Preheating 75: Forward RUN status 76: Reverse RUN status 77: Program Running Indication 78: Program Step Completed Indication 79: Program Running Completed Indication 80: Program Running Paused Indication 81: Multi-pump system error display (only master)

GS10 Analog Common Parameters

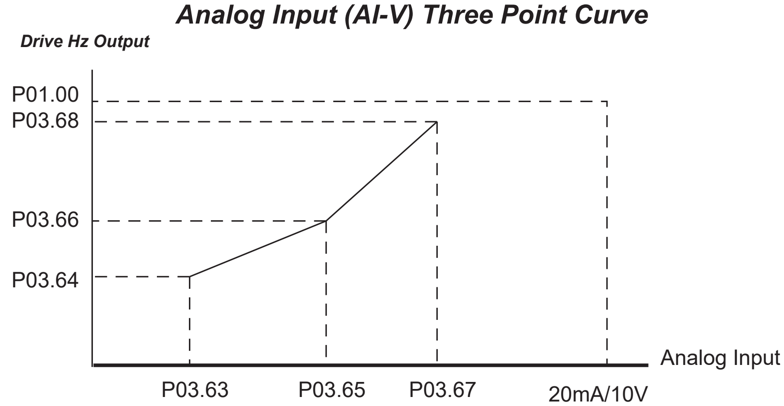
GS10 – AI – Common Parameters				
Parameter		***Selection / Value***	***Default***	***User Selection***
P00.20	Master frequency command source (AUTO, REMOTE)	0: Digital keypad 1: RS-485 communication input 2: External analog input (Refer to P03.00) 3: External UP / DOWN terminal (digital input terminals) 4: Pulse input (DI5) without direction command 6: Not used 7: Digital keypad VR/potentiometer dial (GS10 only) 9: PID controller	0	
P00.30	Master frequency command source (HAND, LOCAL)		0	

GS10 Analog Input (AI-V) Parameters

GS10 – AI Specific Parameters				
Parameter		***Selection / Value***	***Default***	***User Selection***
Terminals		***AI – ACM***	***N/A***	***N/A***
P03.00	Analog input selection (AI)	1: Frequency command 4: PID target value 5: PID feedback signal 6: Thermistor (PTC) input value 11: PT100 RTD input value 12: Auxiliary frequency input 13: PID compensation value	1	
P03.28	AI-V terminal input selection	0: 0–10 V (P03.63–P03.68 is valid)	0	
P03.03	Analog input bias (AI-V)	-100.0% to +100.0%	0	
P03.07	Positive / negative bias mode (AI-V)	0: No bias 1: Lower than or equal to bias 2: Greater than or equal to bias 3: The absolute value of the bias voltage while serving as the center 4: Bias serves as the center	0	
P03.10	Reverse setting when analog signal input is negative frequency	0: Negative frequency input is not allowed. The digital keypad or external terminal controls the forward and reverse direction. 1: Negative frequency input is allowed. Positive frequency = run in a forward direction; negative frequency = run in a reverse direction. The digital keypad or external terminal control cannot change the running direction.	0	
P03.11	Analog input gain (AI-V)	-500.0% to +500.0%	100.0	
P03.15	Analog input filter (LPF) time (AI-V)	0.00~20.00 sec	0.01	
P03.50	Analog input curve calculation selection	0: Normal curve 1: Three-point curve of AI-V 2: Three-point curve of AI-C	0	
Parameters below are used to characterize the GS10 drive output frequency with three point curve parameters if using AI-V for speed reference (bias and gain parameters above are not used when P03.50 ≠ 0).				
P03.63	AI-V votage lowest point	0.00~10.00V	0	
P03.64	AI-V proportional lowest point	-100.00~100.00%	0	
P03.65	AI-V voltage mid-point	0.00~10.00V	5	
P03.66	AI-V proportional mid-point	-100.00~100.00%	50.00	

GS10 – AI-V Specific Parameters (continued)				
Parameter		***Selection / Value***	***Default***	***User Selection***
P03.67	AI-V voltage highest point	0.00~10.00V	10	
P03.68	AI-V proportional highest point	-100.00~100.00%	100.00	

Analog Input (AI-V) Three Point Curve



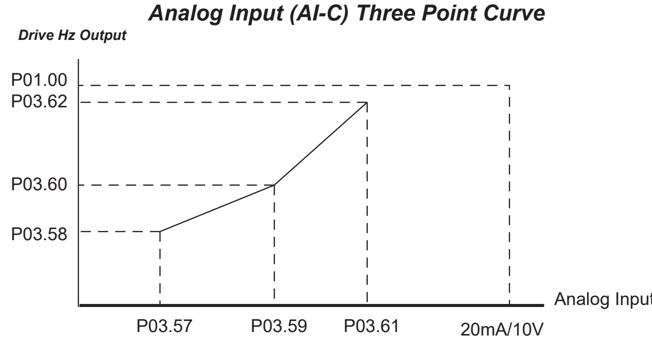
GS10 Analog Input (AI-C) Parameters

GS10 – AI-C Specific Parameters				
Parameter		***Selection / Value***	***Default***	***User Selection***
Terminals		***AI – ACM***	***N/A***	***N/A***
P03.00	Analog input selection (AI)	1: Frequency command 4: PID target value 5: PID feedback signal 6: Thermistor (PTC) input value 11: PT100 RTD input value 12: Auxiliary frequency input 13: PID compensation value	1	
P03.28	AI-C terminal input selection	0: 0-10V 1: 0-20mA 2: 4-20mA	0	
P03.04	Analog input bias (AI-C)	-100.0% to +100.0%	0	
P03.08	Positive/negative bias mode (AI-C)	0: No bias 1: Lower than or equal to bias 2: Greater than or equal to bias 3: The absolute value of the bias voltage while serving as the center 4: Bias serves as the center	0	
P03.10	Reverse setting when analog signal input is negative frequency	0: Negative frequency input is not allowed. The digital keypad or external terminal controls the forward and reverse direction. 1: Negative frequency input is allowed. Positive frequency = run in a forward direction; negative frequency = run in a reverse direction. The digital keypad or external terminal control cannot change the running direction.	0	
P03.12	Analog input gain (AI-C)	-500.0% to +500.0%	100.0	
P03.16	Analog input filter (LPF) time (AI-C)	0.00~20.00 sec	0.01	

GS10 – AI-C Specific Parameters (continued)				
Parameter		***Selection / Value***	***Default***	***User Selection***
P03.50	Analog input curve calculation selection	0: Normal curve 1: Three-point curve of AI-V 2: Three-point curve of AI-C	0	
Parameters below are used to characterize the GS10 drive output frequency with three point curve parameters if using AI-C for speed reference (bias and gain parameters above are not used when P03.50 ≠ 0).				
P03.57	AI-C lowest point	P03.28=1: 0.00~20.00mA P03.28=2: 4.00~20.00mA	P03.28=1: 0.00mA P03.28=2: 4.00mA	
P03.58	AI-C proportional lowest point	-100.00~100.00%	0	
P03.59	AI-C voltage mid-point	P03.28=1: 0.00~20.00mA P03.28=2: 4.00~20.00mA	P03.28=1: 10.00mA P03.28=2: 12.00mA	
P03.60	AI-C proportional mid-point	-100.00~100.00%	50.00	
P03.61	AI-C voltage highest point	P03.28=1: 0.00~20.00mA P03.28=2: 4.00~20.00mA	P03.28=1: 20.00mA P03.28=2: 20.00mA	
P03.62	AI-C proportional highest point	-100.00~100.00%	100.00	

P03.19 (Loss of AI-C) determines the drive behavior if the 4~20mA signal is lost.

Analog Input (AI-C) Three Point Curve



GS10 Analog Output 1 Parameters

GS10 – AO1 Specific Parameters				
Parameter		***Selection / Value***	***Default***	***User Selection***
Terminals		***AO1 – ACM***	***N/A***	***N/A***
P03.20	Multi-function output (AO1)	0: Output frequency (Hz) 1: Frequency command (Hz) 2: Motor speed (Hz) 3: Output current (rms) 4: Output voltage 5: DC bus voltage 6: Power factor 7: Power 8: Output torque 9: AI percent 12: Iq current command 13: Iq feedback value 14: Id current command 15: Id feedback value 16: Vq-axis voltage command 17: Vd-axis voltage command 21: RS-485 analog output 23: Constant voltage output	0	
P03.21	Analog output gain (AO1)	0.0~500.0%	100.0	
P03.22	Analog output in REV direction (AO1)	0: Absolute Value 1: 0V When Negative 2: Offset 5V = 0 Value	0	
P03.27	AO1 output bias	-100.00–100.00%	0.00	
P03.32	AO1 DC output setting level	0.00~100.00%	0.00	
P03.35	AO1 output filter time	0.00–20.00 sec.	0.01	

Using GS10 AC Drives with AutomationDirect PLCs

Appendix C

Table of Contents

Appendix C Overview

The material presented here will help you connect your GS10 drive to an ADC PLC. The concepts and techniques used can also be applied to any 3rd party PLC.

There are two ways a PLC can control the drive; via communications or via physical inputs. The GS10 supports serial Modbus via the built-in RS-485 connections.

GS10 supports a variety of I/O on the main control board.

- *5 Sinking/sourcing DC inputs (includes 1 Hi-speed pulse input, 30V/30mA/33kHz max)*
- *1 Sinking/sourcing DC output*
- *1 Form C relay output (inductive load [cosØ 0.4] 1.2A [NO or NC] @ 250VAC)*
- *1 Analog input (0~10V, -10~10V, 0~20 mA, 4~20 mA)*
- *1 Analog output (0~10V, -10~10V, 4~20 mA)*

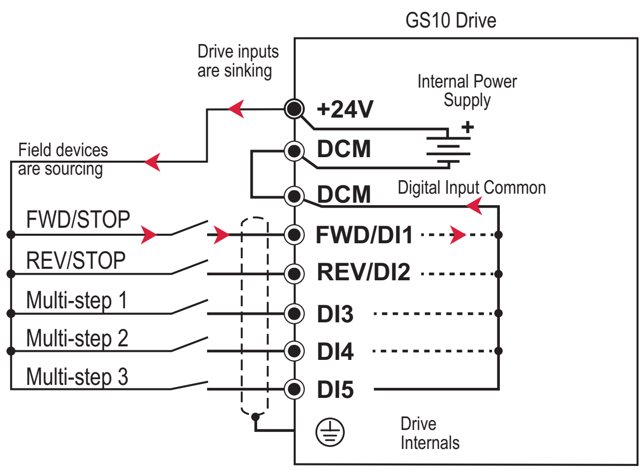
Sinking/Sourcing Basics

GS10 DC inputs and outputs can be sinking or sourcing, depending on how they are wired. If you understand the basics of how sinking and sourcing work, the two options can be easily applied.

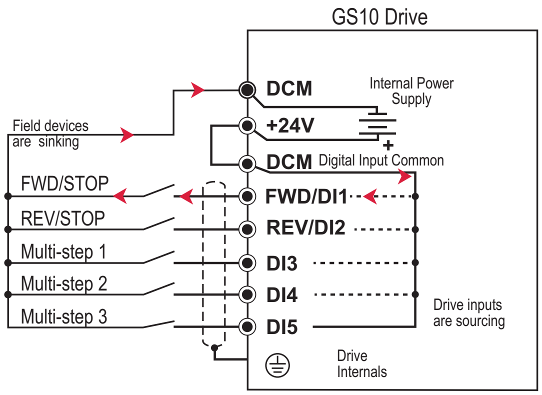
- *For a detailed technical explanation of sink and source, please follow this link: www.automationdirect.com/static/specs/sinksource.pdf*

The term “sinking” means that the device “sinks” current into itself. It does not supply current. Sinking inputs are ON when you apply voltage (and thus, current) to them. A “sinking” device needs to have a “sourcing” device attached to it to supply current.

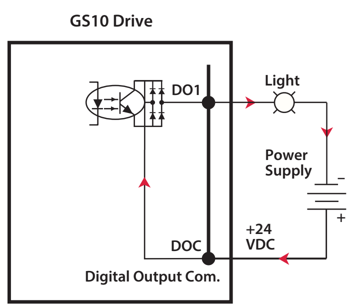
So, if the GS10 inputs are wired for sinking, they require the external device (FWD/STOP switch in this example) to supply current (when closed, the external device will “source” current). Notice the current flow represented by the red arrows. The GS10 input “sinks” the current flow.



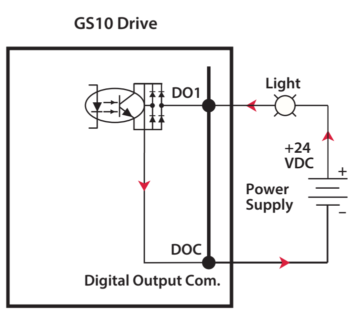
GS10 DC inputs can also be wired for sourcing. In this configuration, notice that the 24VDC supply is feeding into the DIC (Digital Input Common) terminal and the current is coming out of the drive input (GS10 is sourcing) and the field device is sinking the current.



GS10 DC outputs can also be wired as sinking or sourcing. A sourcing output supplies current. This requires a device (pilot light, buzzer, PLC input card) that will sink the current. Notice how the electronics of the output allow current to flow out the DO1 terminal. The DOC (Digital Output Common) terminal is connected to +24VDC.



The same drive output circuit can be used to sink current. Notice below that the DOC terminal is now connected to the power supply common. The pilot light sources the current into the drive. The drive output sinks the current. (Even though the light has 24V on it at all times, it will not light up unless current is flowing through it and into the drive output).

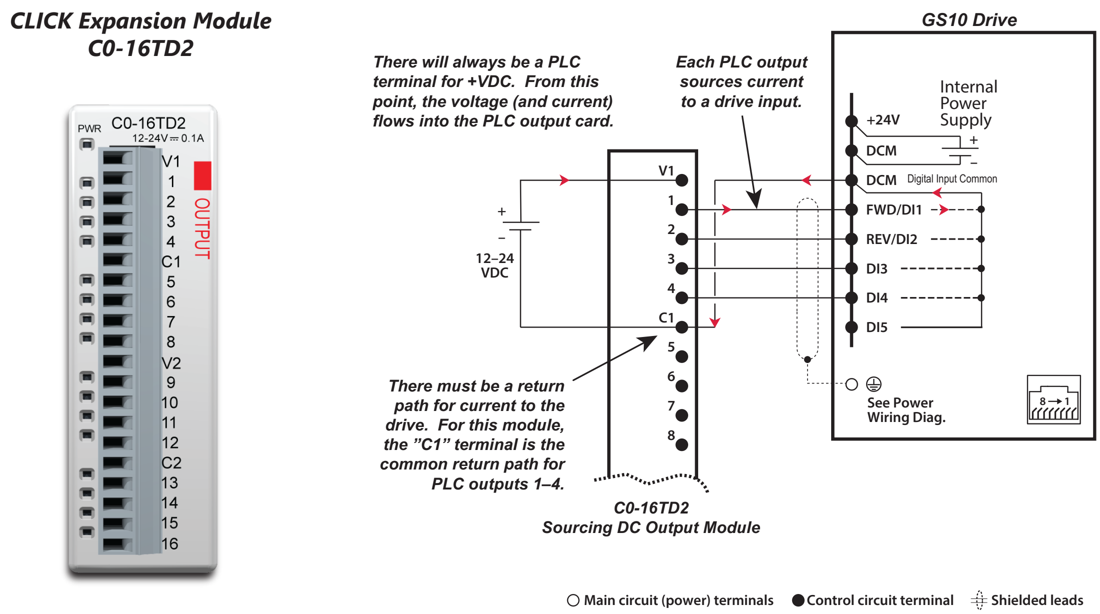


NOTE: GS10 output can be wired as sinking or sourcing, but not both at the same time.

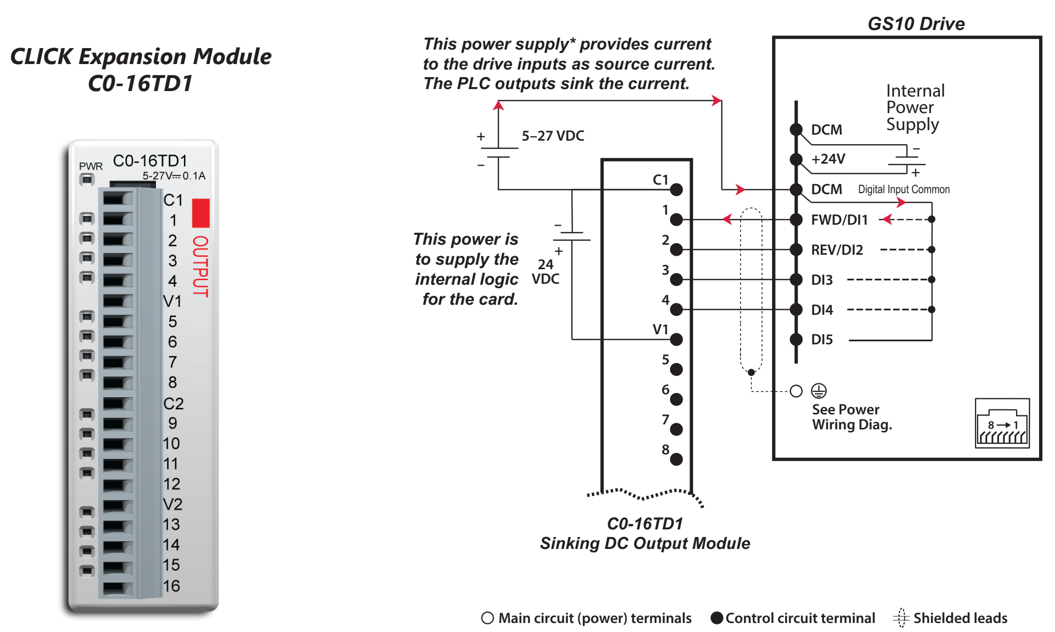
GS10-to-PLC I/O Wiring Examples

This section shows typical wiring examples of PLC inputs and outputs connected to a GS10 drive. While we are using CLICK PLCs in the examples, the samples should be relevant to most PLCs. The terminal designation of other PLCs may be different, but the general connections should be the same (i.e. in the 1st example below, all PLC sourcing output modules will have a +VDC connection, a DC common terminal, and individual outputs). In the examples below, we make note of the typical connections involved. We also indicate current flow (with red arrows) to emphasize which modules are sourcing and which modules are sinking.

Drive Wired with DC Sinking Inputs (PLC output card is sourcing)



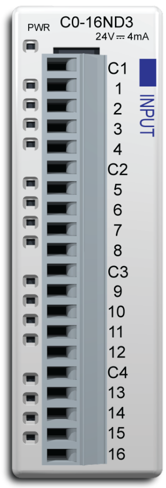
Drive Wired with DC Sourcing Inputs (PLC output card is sinking)

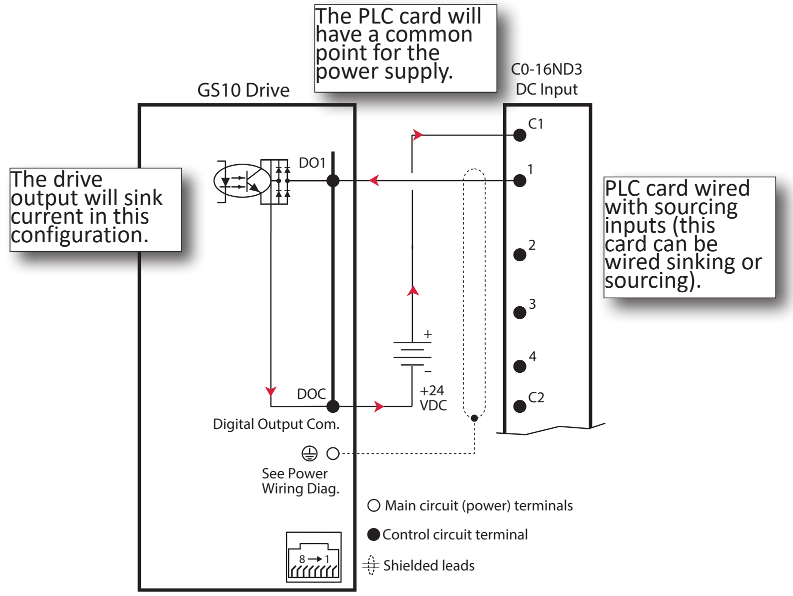


*Alternately, the drive internal power supply (+24V) could be used. However, the DCM common would have to be connected to the PLC power supply common.

Drive Wired with DC Sinking Outputs (PLC input card is sourcing)

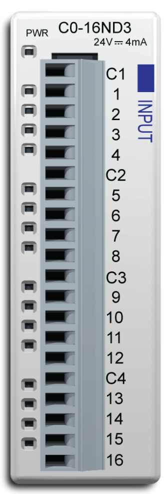
CLICK Expansion Module C0-16ND3

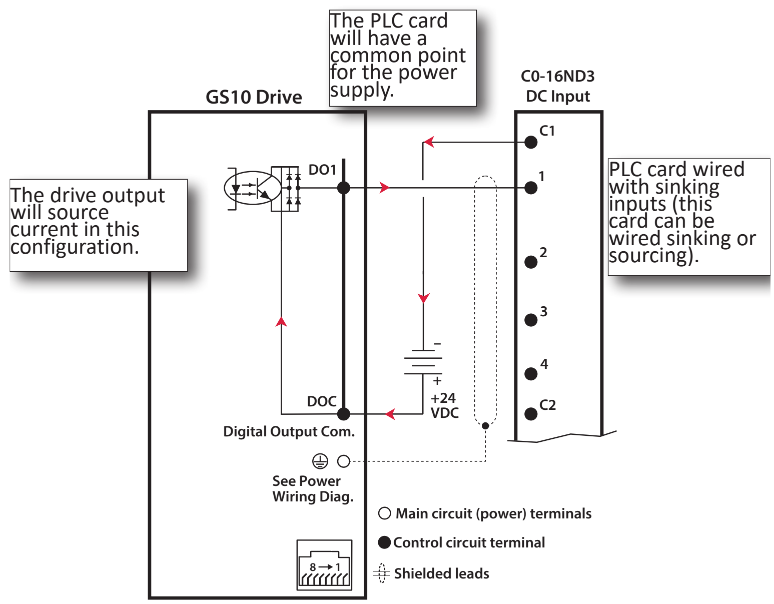




Drive Wired with DC Sourcing Outputs (PLC input card is sinking)

CLICK Expansion Module C0-16ND3

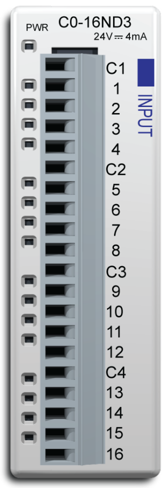


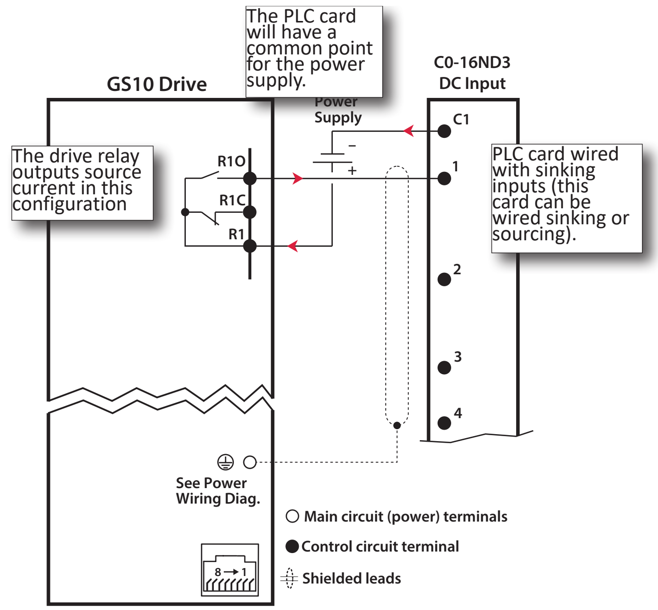


Drive Relay Outputs Wired with Sinking PLC Modules

In this example, the inputs are wired to the Normally-Open contacts (R1O). You could also wire to the Normally-Closed contacts (R1C), but you would not be able to tell if the drive lost power or if the drive outputs are simply OFF.

CLICK Expansion Module C0-16ND3

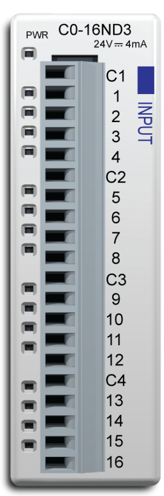


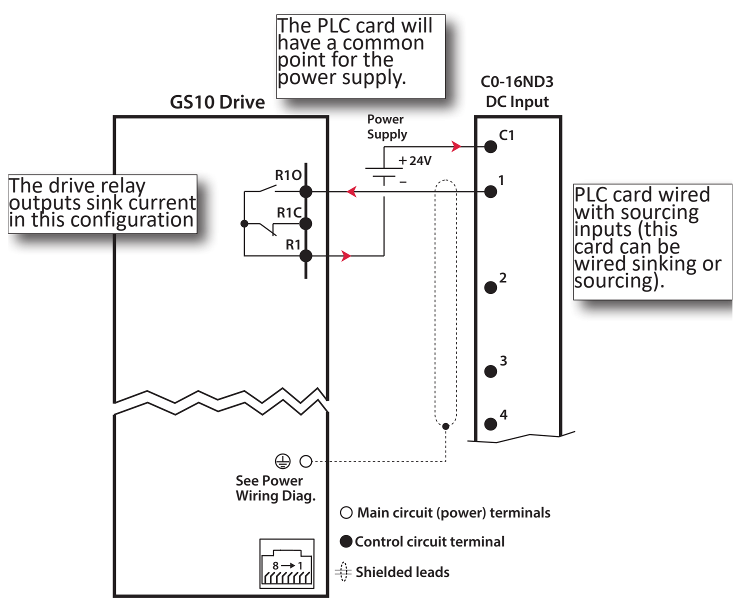


Drive Relay Outputs Wired with Sourcing PLC Modules

In this example, the inputs are wired to the Normally-Open contacts (R1O). You could also wire to the Normally-Closed contacts (R1C), but you would not be able to tell if the drive lost power or if the drive outputs are simply OFF.

CLICK Expansion Module C0-16ND3





Drive Analog Inputs

The GS10 has 1 analog input (AI) that can be configured for a variety of input functions. AI must be configured via drive parameters group 3 and DIP switches. AI can be configured for voltage or current input. Both inputs have a variety of settings in Parameter Group 3 (P03.xx) that allows you to customize their scaling, offset, etc. based on voltage or current setting.

- *AI-V: 0~10V*
- *AI-C: 4~20 mA, 0~20 mA*

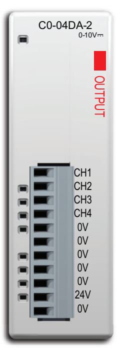
Connecting the analog input to PLC outputs is very straightforward.

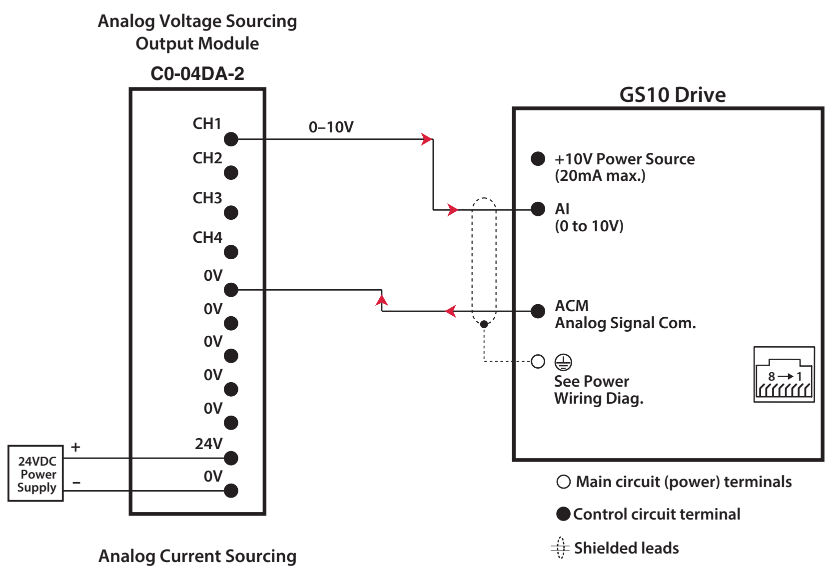
NOTE: The GS10 AI analog input does not supply the current when configured for 0~20 mA or 4~20 mA (AI-C mode). The analog output device needs to supply the loop power.

Analog Input Wired for Voltage and Current

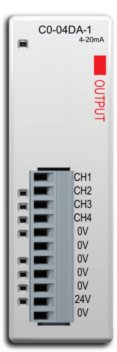
In this example, for the first drive AI is configured for 0~10V (P03.28=0, AI-V). For the second drive, AI is configured for 4~20 mA (P03.28=2, AI-C).

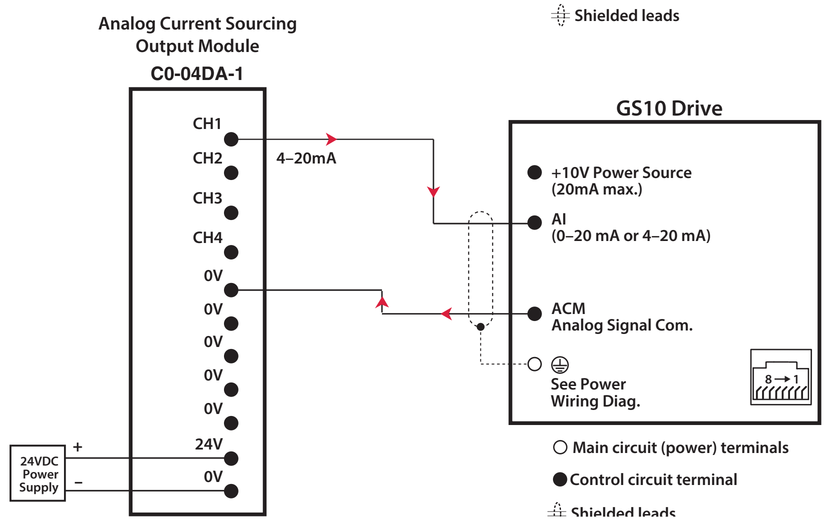
CLICK Expansion Module C0-04DA-2





CLICK Expansion Module C0-04DA-1



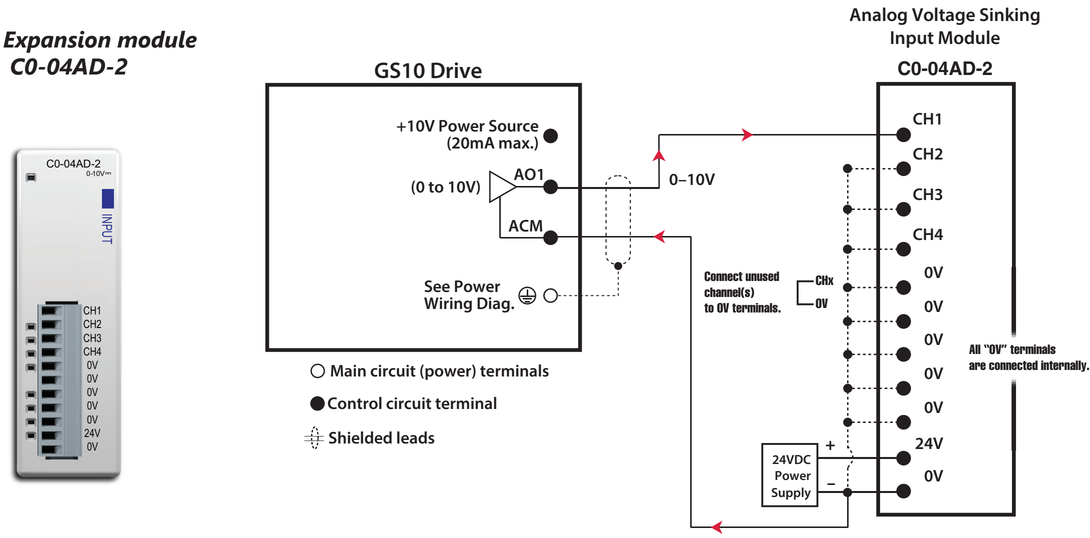


Drive Analog Outputs

The GS10 has one analog output (AO1) specified for 0-10V only. There are several parameters associated with the analog output that defines the signal and adjusts gain, offset, etc.

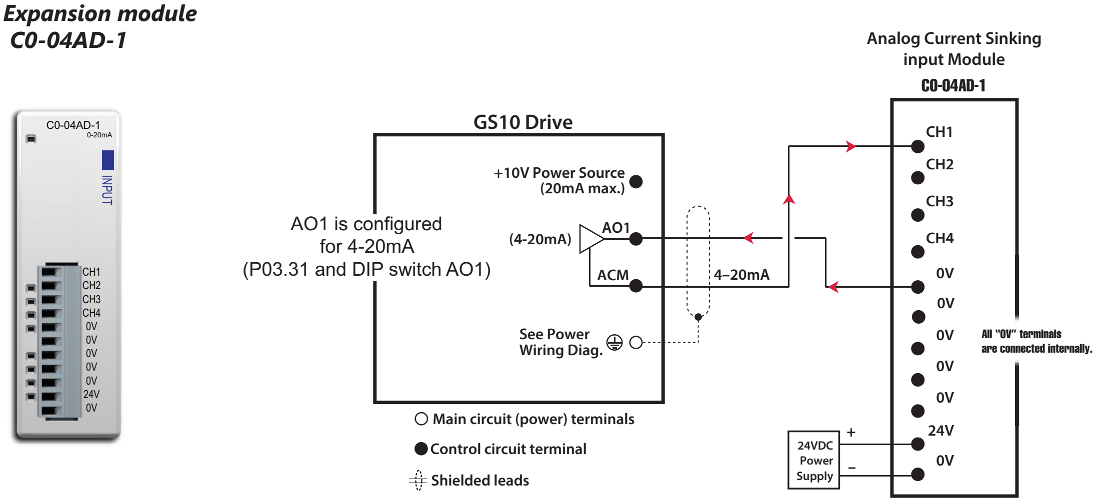
Analog Output Wired for Voltage and Current

CLICK Expansion module C0-04AD-2



In this example AO1 is configured for current signal, 4-20mA (P03.31 and DIP switch AO1).

CLICK Expansion module C0-04AD-1



PID Control

Appendix D

Table of Contents

Function of PID Control

GS10 series AC drives can be used to control an automated process by the Proportional-Integral-Derivative (PID) control method.

A PID Configuration Spreadsheet tool is available for download from the drive item page support resources section.

What Does PID Control Accomplish?

The primary benefit of PID control is that it acheives and maintains the desired steady-state condition of a process better and more smoothly than does ON-OFF control.

The GS10 drive PID algorithm constantly assesses the amount and rate of change of the quantity being controlled (Process Variable) and its deviation (Process Error) from the desired steady-state value (Setpoint). The GS10 drive then variably adjusts its frequency output as much or as little as needed to keep the Process Variable as close as possible to the Setpoint.

Simple ON-OFF control systems, on the other hand, continually bounce back and forth above and below the Setpoint value, but cannot maintain the Process Variable at the Setpoint value.

PID Control Analogy

PID controllers are all around us. Many times we don't realize that we are the PID controller in a control loop. For example, the driver of a car is the PID controller for the car's speed.

PID Control System Variables:

- *Desired Speed ≈ Setpoint*
- *Actual Speed ≈ Process Variable*
- *Gas Pedal ≈ Control Variable*
- *Speedometer ≈ Feedback*

Proportional Control: The farther away you are from your Desired Speed, the more you press the gas pedal. If you did this starting from a stand-still, you would floor it and probably shoot far past the Desired Speed. Once the speed "settled in," you would never hold exactly at your Desired Speed because the difference between Desired and Actual Speed would get very small and you only have so much control over the pedal and your foot; not enough to hold the perfect speed consistently. So, Proportional Control adjusts the output based on the *difference* between the Setpoint and Process Variable much more accurately in a fine-tuned way.

Integral Control: If your Desired Speed is 70mph and your car consistently goes 69mph, you will realize that you need to press the gas pedal a little more (to overcome wind resistance, a hill, etc.). The longer you are under the Desired Speed, the more gas you give the car. That is fundamentally what Integral Control does; adjust the output based on *how long* the system is away from the setpoint.

Derivative Control: In the situation above, assume that you start going up a hill. The car's Actual Speed gets farther away from the Desired Speed, so the Proportional Control makes you press the gas pedal more. The longer the speed stays below setpoint, Integral Control makes you press the gas even more. Now assume that your car tops the hill and starts going downhill. Your speed suddenly gets faster (the error between Desired Speed and Actual Speed), so Proportional causes you to slightly let off the gas. But Integral still keeps adding to the pedal (since you still haven't reached Desired Speed). Your internal Derivative Control sees that you are rapidly approaching the Desired Speed, so you begin to let off the gas quickly. That is Derivative Control; it adds or subtracts to the Control Variable based on *how quickly* the system is approaching (or leaving) the setpoint.

Common Applications for PID Control

1) *Flow control: A flow sensor is used to feed back the flow rate in a pipe, and the GS10 drive PID adjusts its output frequency to the pump that forces the liquid or gas throught that pipe.*
2) *Level control: A level sensor is used to feed back the liquid level in a resevoir or tank, and the GS10 drive PID adjusts its output frequency to the pump that fills or empties that tank.*
3) *Pressure control: A pressure sensor is used to feed back the pressure in a tank, and the GS10 drive PID adjusts its output frequency to the pump that pressurizes or vacuums that tank.*
4) *Speed control: A speed sensor is used to feed back the shaft speed of a motor or machine driven by that motor, and the GS10 drive PID adjusts its output frequency to that motor.*
5) *Temperature control: A thermocouple or thermistor is used to feed back the temperature of an area or device, and the GS10 drive PID adjusts its output frequency to the fan that affects that temperature.*

Definition of PID Loop "Directions"

Please note that the following nomenclature describes how the GS10 PID system operates, which may differ from the operation of some other PID systems.

Forward-Acting PID Loop (Heating Loop) (Negative-Feedback Loop)

The terms "Forward-Acting," "Direct-Acting," "Heating," and "Negative-Feedback" are used to describe a PID loop that can be used to control processes such as pressure, heating, and flow (among others).

- *Greater Output Frequency (Hz) drives the Process Variable (PV) upward toward the Setpoint (SP)*
- *GS10 drive frequency output increases if the Process Error is negative (SP>PV)*

Reverse-Acting PID Loop (Cooling Loop) (Positive-Feedback Loop)

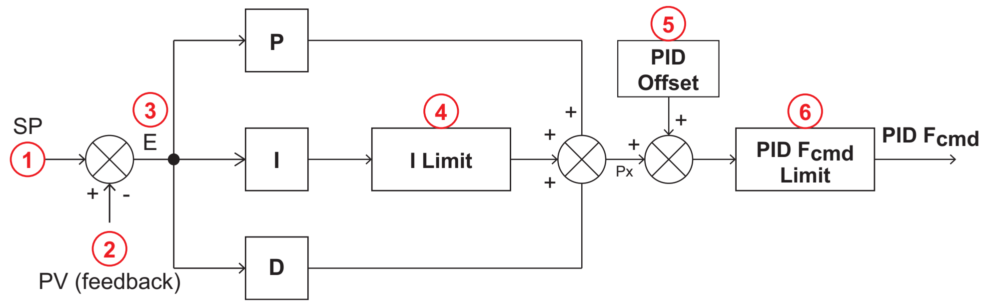
The terms "Reverse-Acting," "Cooling," and "Positive-Feedback" are used to describe a PID loop that can be used to control applications such as cooling.

- *Greater Output Frequency (Hz) drives the Process Variable (PV) downward toward the Setpoint (SP)*
- *GS10 drive frequency output increases if the Process Error is positive (SP<PV)*

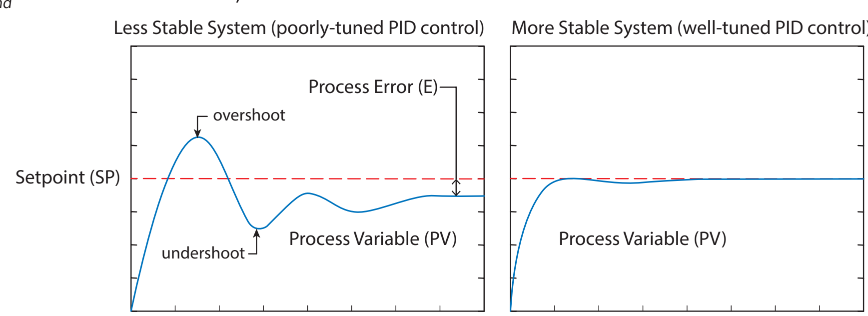
PID Control Overview

PID control is a closed output and feedback loop for the purpose of automatically controlling a portion of a process to a specific condition by utilizing a target setpoint and the process's actual condition as feedback to the controller. You determine the setpoint and let the system reach that setpoint using the process's conditional feedback and the PID control system.

- *P = Proportional control (also known as "Gain")*
- *I = Integral control (also known as "Reset")*
- *D = Derivative control (also known as "Rate")*
- *Process Variable (PV) = the quantity being measured and controlled*
- *Setpoint (SP) (also known as Target Value) = the desired value of the Process Variable*
- *Error (E) = the difference between the Setpoint and the Process Variable*



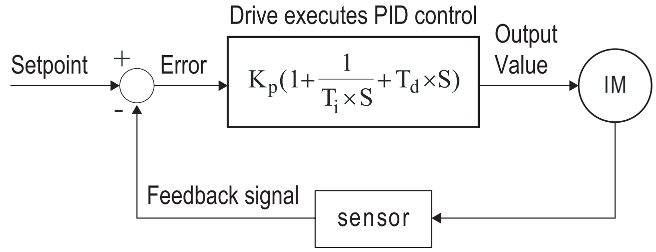
1) *Setpoint: -100% to +100% (PID Setpoint Gain + PID Setpoint Offset)*
2) *Feedback: -100% to +100% (Feedback Gain)*
3) *Error: -100% to +100% (in percent change)*
4) *I Limit: 0~150% (Upper Limit for Integral Time P08.04)*
5) *PID Offset: P08.16 determines how the PID Offset will be controlled; by P08.17, or by an Analog Input (P03.00)*
6) *PID F_{cmd} Limit: See P01.10, P01.11*



Since a PID controller relies only on the measured Process Variable, instead of knowledge of the underlying process, it is applicable to a broad variety of system processes. By tuning the three parameters of the model, a PID controller can deal with specific process requirements. The response of the controller can be described in terms of its responsiveness to an error, the degree to which the system overshoots a setpoint, and the degree of any system oscillation. The use of the PID algorithm does not guarantee optimal control of the system or even its stability.

Some applications may require using only one or two terms to provide the appropriate system control. This is achieved by setting the other parameters to zero. A PID controller is called a PI, PD, P, or I controller in the absence of the other respective control actions. PI controllers are fairly common, since Derivative action is sensitive to measurement noise, whereas the absence of an Integral term may prevent the system from reaching its target value.

Concept of GS10 PID Control & Tuning



K_p: Proportional Gain (P) T_i: Integral Time (I) T_d: Derivative Value (D) S: Operator

When ***GS10 drive PID is enabled by P08.00 [PID Action/Mode]***, P08.65 "reflects" the PID Setpoint Source determined by what is set in P00.20 (Remote) or P00.30 (Local), and what Mode the Drive is in, i.e. Remote or Local Mode. PID control operates with the feedback signal as reflected by P08.65 either 0~10V voltage or 4~20mA current.

Proportional Gain (P)

The first parameter of GS10 PID control is *Proportional Gain (P08.01)*.

The GS10 drive's frequency output is proportional to the Process Error (when the GS10 is configured for PID control). If only the Proportional Gain control component is used, the controller will not be able to get the Process Variable to exactly match the Setpoint at steady-state.

For a given process, if the Proportional Gain value is set too low, the control action will be too sluggish. If the Proportional Gain value is set too high, the control action will be unstable. To find the correct setting for Proportional Gain, set the Integral Time (I) and Derivative Value (D) to zero (0). Begin tuning the process with a low Proportional Gain value, and increase the Proportional value until the system becomes unstable. When instability is reached, reduce the Proportional value slightly until the system becomes stable (smaller values reduce system gain).

Integral Time (I)

The second parameter of GS10 PID control is *Integral Time (P08.02)*.

The GS10 drive's frequency output compensation due to the integral component is proportional to the integral of the Process Error. To eliminate the steady-state Process Error, an "integral component" needs to be added to the controller.

The Integral Time (I) decides the relation between integral component and Process Error. The integral component will be increased even if the error is small. It gradually increases the controller output to eliminate the error until it is 0.

Begin tuning with a higher number for Integral Time (100.0 is max; 1.0 is default), and slowly move to a smaller number until you reach the setpoint with minimized overshoot/undershoot. Tuning is normally done utilizing the GSoft2 software scope function (or an oscilloscope) to monitor the Process Variable as you incrementally change the Integral Time value until the Setpoint is satisfactorily maintained.

- *Overshoot: The Process Variable moves further past the Setpoint than desired.*
- *Undershoot: The Process Variable does not reach the desired Setpoint.*

Refer to "Tuning Example for PID Control" on page D–7 of this appendix for more PID tuning information.

Derivative Value (D)

The third parameter of GS10 PID control is Derivative Value (P08.03).

The GS10 drive's frequency output compensation due to the derivative component is proportional to the derivative of the Process Error. Derivative Value (D)control is performed based on the quickness of changes in the Process Error.

When the Proportional Gain (P) and Integral Time (I) control components are set to eliminate the Process Error so that the system runs at steady state, outside forces may suddenly cause oscillation or instability within the system. Without a Derivative Value component, the control output may be too sluggish to quickly respond to these sudden changes. The derivative component can suppress these effects by acting before the error occurs.

Begin tuning with a high Derivative Value and reduce the value to the point of system instability. Then increase the Derivative Value until the control output regains stability. Stability can be tested by moving between two wide-spread setpoint values.

Since Derivative Control is performed based on sudden changes in Process Error, it is a very sensitive control. Therefore, it may also react to extraneous signals and noise, and can easily lead to unstable system control. Derivative control is not normally required for the control of processes such as flow, pressure and temperature.

Refer to *"Tuning Example for PID Control" on page D–7* *of this appendix for more PID tuning information.*

Proportional Integral Control (PI)

When processes are controlled by Proportional Gain only, Process Error cannot be eliminated entirely. Proportional + Integral control (PI) can be used to eliminate Process Error incurred by the targeted value changes and the constant external disturbances. However, if the I action is excessively powerful, it will delay the responding correction, and will allow unstable system operation.

Proportional Derivative Control (PD)

In deciding when to use Proportional-Derivative Control, we need to understand how the system would react as a Proportional-Integral-Derivative system. When a Process Error due to a disturbance in the process occurs in a controlled system, the system sees a greater load than the derivative has provided energy to control. If that Process Error is small, the system PV can oscillate if the Proportional Gain and the Integral Time are being applied to the system too often within a small length of time. To prevent this type of system reaction, the use of Proportional and Derivative (PD) alone may be warranted. The use of Proportional Gain *and* the feed-forward action of the Derivative Value can result in a faster-acting operation to stabilize the system.

Proportional Integral Derivative Control (PID)

When choosing to use Proportional-Integral-Derivative (sometimes called PID) control, the Integral Time is utilized to provide better control of the Process Error while the Derivative Value is used to restrain PV oscillation.

Tuning Example for PID Control

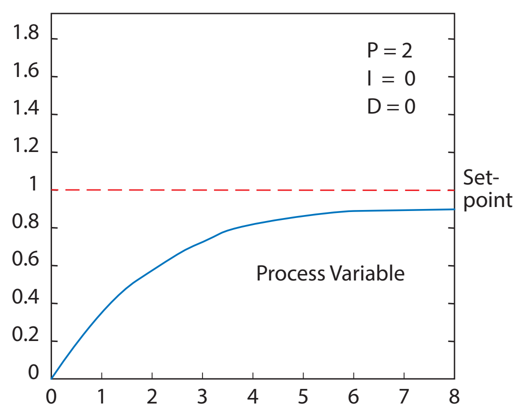
The PID settings should be adjusted, or “tuned,” with the controlled process in actual operation while monitoring the actual Process Variable.

We recommend starting by first adjusting the Proportion Gain only, with the Integral Time and Derivative Value set to zero. The following hypothetical example illustrates PID tuning with settings as shown:

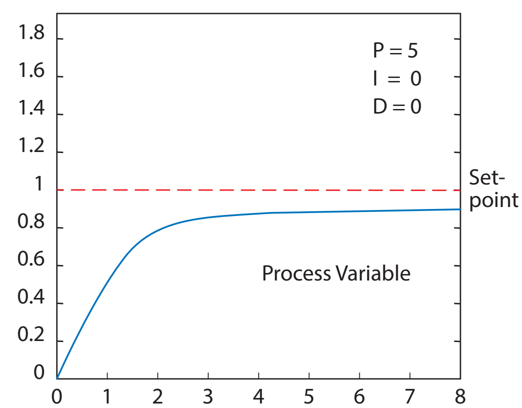
- *P = Proportional Gain = GS10 drive parameter P08.01,*
- *I = Integral Time = GS10 drive parameter P08.02,*
- *D = Derivative Value = GS10 drive parameter P08.03.*

Proportional Gain: Adjust the P setting so that the PV response is neither too sluggish, nor too fast, and without excessive overshoot or undershoot. (Process error cannot be eliminated by P)

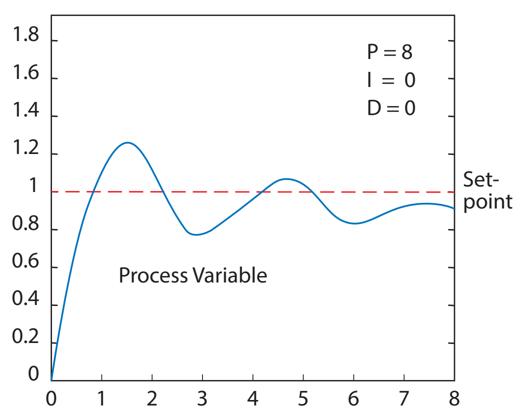
Sluggish PV response; process error



More practical PV response; process error



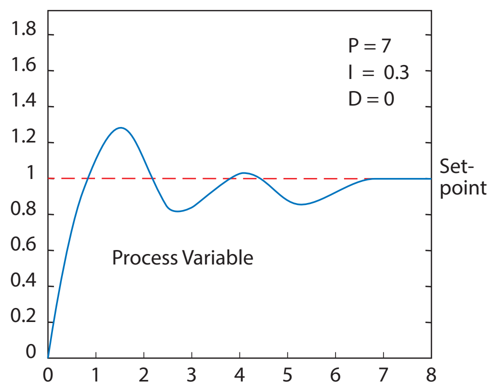
Overshoot & undershoot; process error

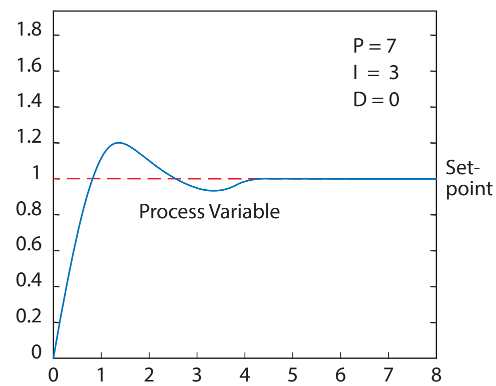


(Example continued next page)

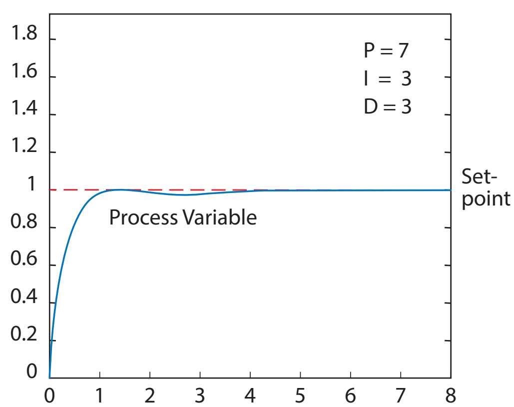
PID Tuning Example (continued)

Integral Time: Adjust the I setting to minimize over/undershoot, and to eliminate the process error.





Derivative Value: Adjusting the D setting may not be neccessary for all processes, but it can be particularly helpful in reducing over/undershoot and instability that may be caused by sudden changes in the system input variable.



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